Quartz PLL

DIRECT DRIVE TURNTABLE

PLC-590

SERVICE MANUAL

PIONEER

CONTENTS

1. SPECIFICATIONS

MOTOR AND TURNTABLE

Motor . . . . . Quartz PLL Hall motor
Turntable Platter . . . . . 320mm diam. aluminum alloy die-cast
Internal Mass . . . . . 350kg/cm² (including platter mat mass)
Speeds . . . . . 33-1/3 and 45 rpm
Speed Control Range . . . . . ±6%
Wow and Flutter . . . . . Less than 0.025% (WRMS)
Signal-to-Noise Ratio . . . . . More than 75dB (DIN-B)
(with Pioneer cartridge model PC-1000/II)

ROTATIONAL CHARACTERISTICS

Build-up Time . . . . . Within 180° rotation at 33-1/3 rpm
Speed Deviation . . . . . Less than 0.002%
Speed vs. Load Characteristics . . Stable up to 120 grams drag load
Speed Drift . . . . . Less than 0.0003%/h at 33-1/3 rpm
Less than 0.00004%/degree temp. change at 33-1/3 rpm

SUBFUNCTIONS

Pitch indicator
All-electronic brake
Free stop hinges
Insulator feet

SEMICONDUCTORS

ICs 6
Transistors 26
Diodes 13
Hall elements 3

MISCELLANEOUS

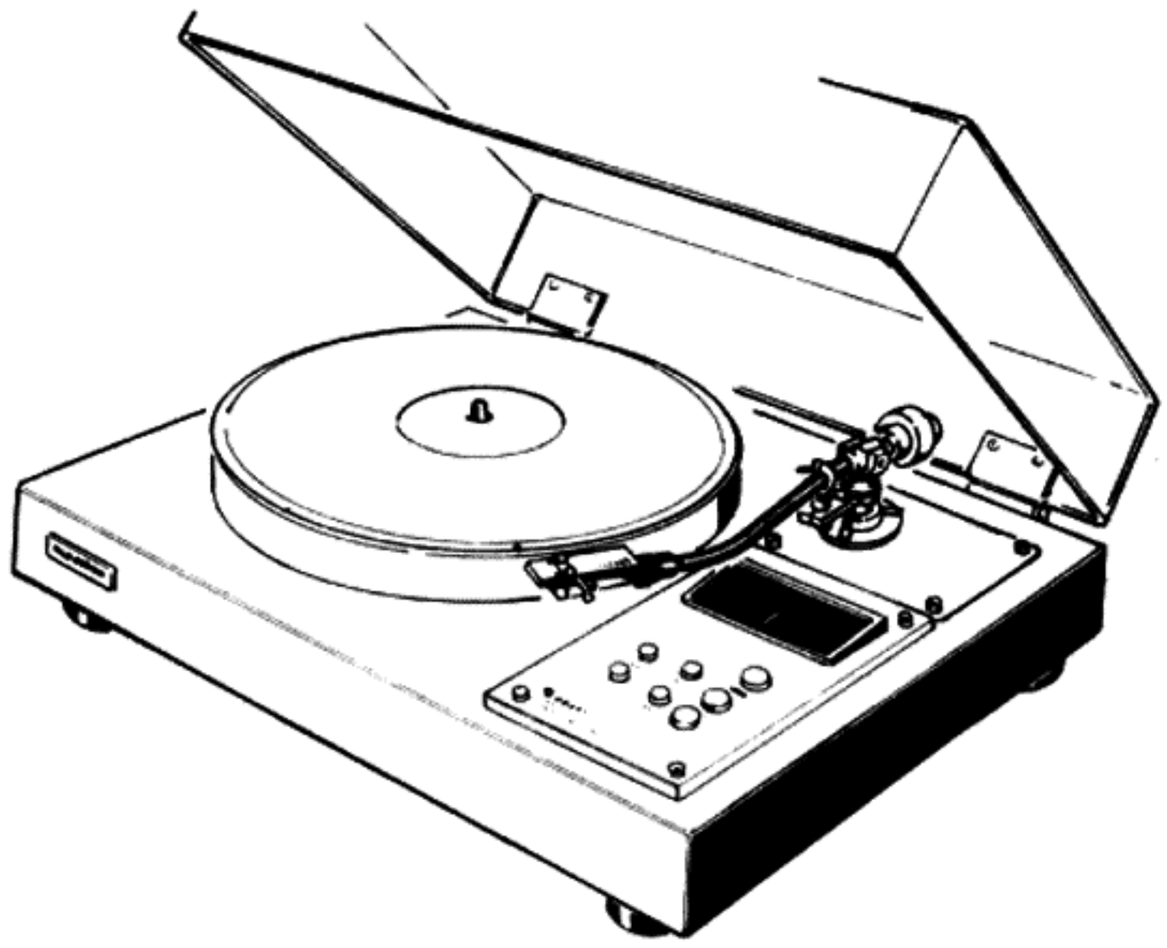
Power Requirements . . . . . AC 120V 60Hz
Power Consumption 12W
Dimensions . . . . . 490(W) x 185(H) x 406(D)mm
19-5/16(W) x 7-5/16(H) x 16(D)in
Weight . . . . . 14.5kg/31 lb 15 oz

ACCESSORIES

45 rpm adaptor 1
Arm rest 1
Hexagonal wrench 1
Regular tonearm mounting board 1
Regular tonearm mounting papers 2
SME-3009/II aluminum plate 1
Aluminum plate for PA-1000 1
Machined mounting board 1
Screws for SME-3009/II 4
Washers for SME-3009/II 4
Nylon washers 4
Operating instructions 1

NOTE:
Specifications and design subject to possible modification without notice, due to improvements.

2. PANEL FACILITIES



45 RPM ADAPTOR

Place this adaptor over the center shaft when playing EP (large hole) records at 45 RPM.

SPEED ADJUSTMENT KNOB (SPEED ADJ.)

Turn this knob, with the Quartz LOCK switch set to the OFF position, to increase or decrease the platter speed. Turn it in the (+) direction to increase the speed, and in the (–) direction to decrease the speed.

QUARTZ LOCK SWITCH

When this switch is depressed (ON▬), the quartz PLL circuit becomes operational and the speed of the platter is locked accurately to the rated speed (45 or 33-1/3), depending on the setting of the speed buttons.
(When set to the ON position, the illuminated meter scale goes off, and the words 'Quartz Lock' light up).

33-1/3 RPM BUTTON

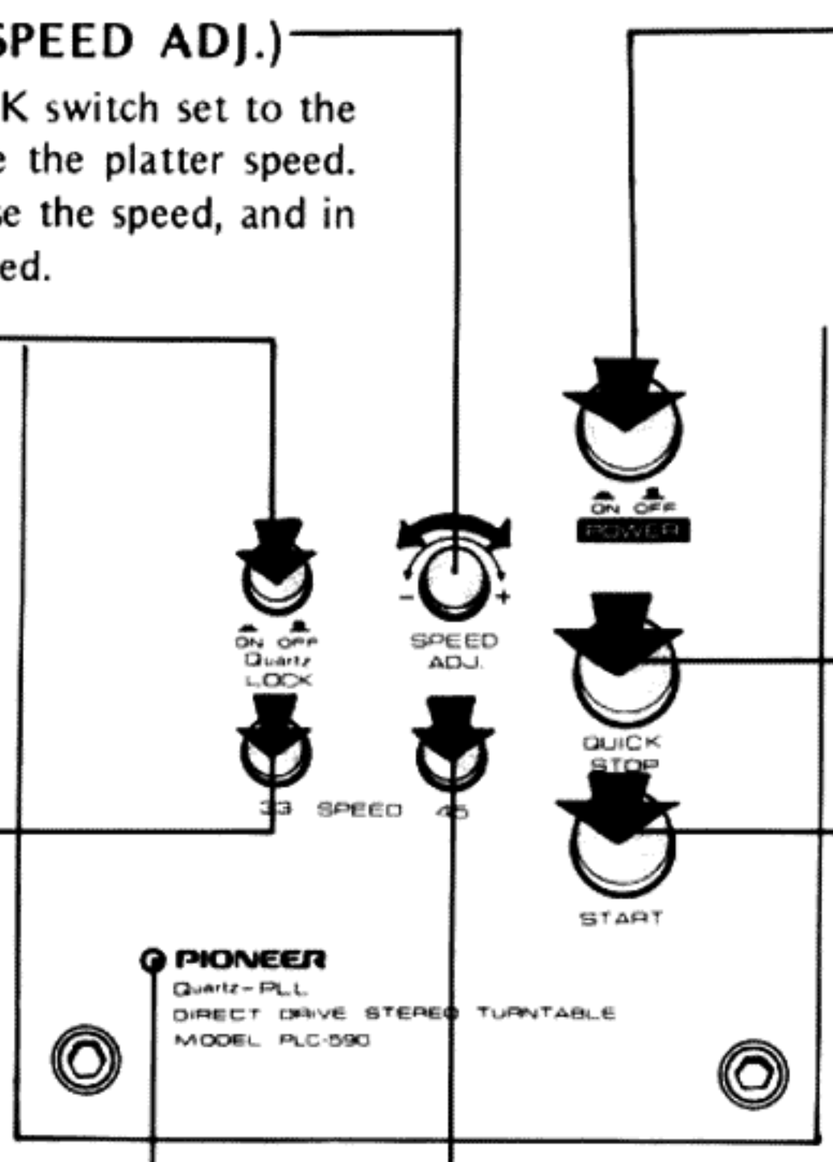
Depress this button when playing a 33-1/3 RPM record.

45 RPM BUTTON

Depress this button when playing a 45 RPM record.

POWER INDICATOR

This indicator lights up as soon as the POWER switch is depressed and power is supplied to the turntable.



POWER SWITCH

Power is supplied to the PLC-590 when this switch is depressed (ON▬). (The power indicator lights up and the speed is indicated on the meter panel). Releasing this button cuts off the power, and the platter stops.

QUICK STOP BUTTON

Depress this button to turn the motor off.

START BUTTON

The platter starts to rotate when this button is depressed.

QUARTZ LOCK INDICATOR

When the Quartz LOCK switch is depressed to the ON position, and the platter speed is locked to the rated speed (45 or 33-1/3 RPM) depending on the setting of the speed buttons, then this indicator lights up.

33-1/3 RPM INDICATOR

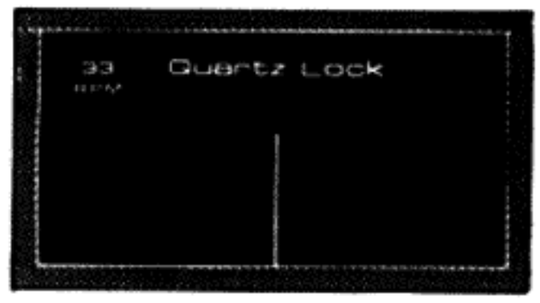
This lights up to indicate that the platter is rotating at a speed of 33-1/3 RPM.

45 RPM INDICATOR

This lights up to indicate that the platter is rotating at a speed of 45 RPM.

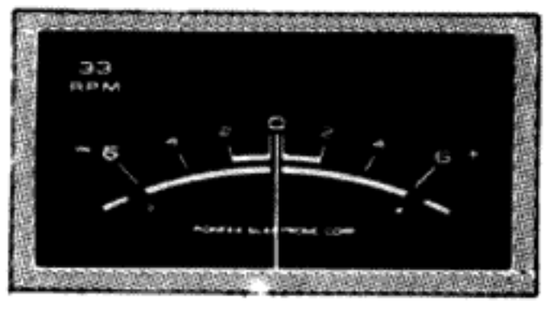
PITCH INDICATOR

When the Quartz LOCK switch is released (OFF position), then the pitch indicator scale is illuminated. You can read out the percentage of the RPM deviation (%) from the rated platter speed indicated at the top left or right of the meter when turning the speed adjustment knob.



QUARTZ LOCK ON

This is how the panel looks when the Quartz LOCK switch is depressed (ON position): the Quartz Lock indicator and the speed indicator both light up.



QUARTZ LOCK OFF

This is how the panel looks when the Quartz LOCK switch is released (OFF position): the speed indicator and the pitch indicator meter scale are both illuminated.

3. CIRCUIT DESCRIPTIONS

Refer to Service Manual PXM-051 for the principles of rotation of the motor (PXM-051) and troubleshooting. The meter drive circuit and START-STOP circuit are described here.

3.1 METER DRIVE CIRCUIT (See Fig. 3) (PWX-010)

1. The Pulse width at the OF_2 terminal of the drive control ass'y (PWG-012) at PXM-051 is a constant 2.5ms and a frequency proportional to the speed is output (Fig. 1).
(222.2Hz at 33rpm, 300Hz at 45rpm)

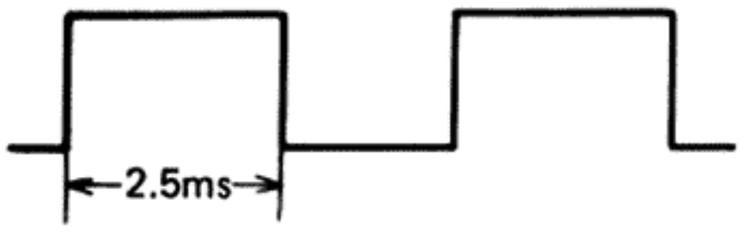


Fig. 1

2. The OF_2 output is applied to Q_1 of the meter drive circuit. Thereafter, it is shaped by the Schmitt trigger circuit of Q_2, Q_3 and 33, 45rpm level setting is performed by switching the emitter resistance of Q_1 by means of S_2.

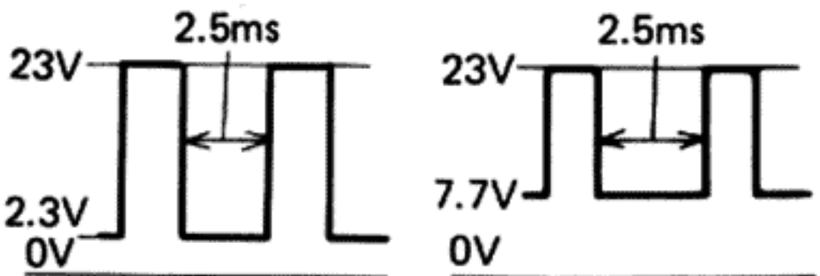


Fig. 2

3. The output of the Schmitt trigger circuit is passed thru a two-stage RC integrating circuit consisting of R_7, C_1 and R_8, C_2 to reduce the ripple and then applied to the IC as a DC voltage proportional to speed.
4. There are two OP amps forming a differential amplifier inside the IC. The DC voltage proportional to the speed is detected and applied to AMP 1. The reference voltage obtained by dividing +B23V by R_{23}, R_{24} is applied to AMP 2.
5. After the detected voltage and reference voltage have been compared, the output is amplified about 26dB by the differential amplifier and sent to the voltage comparator circuit (Q_4, Q_5, Q_6) thru D_1, D_2.

At Quartz Lock ON

6. In the normal state when the detected voltage and reference voltage are equal (rated speed), Q_4 of the voltage comparator circuit is turned OFF, Q_5 and Q_6 turned ON. Q_{24} in the power supply ass'y (PWR-012) is turned ON and the Quartz Lock lamp lights.
7. If the speed of the turntable deviates more than ±5%, the output of the differential amplifier turns Q_4 ON, Q_5 OFF, Q_6 and Q_{24} are turned OFF and the Quartz Lock lamp is extinguished.

At Quartz Lock OFF

8. The output of the differential amplifier is applied directly to the meter which is deflected according to the speed.
9. Since the output of Q_6 is grounded by S_3, the Quartz Lock lamp is not illuminated.

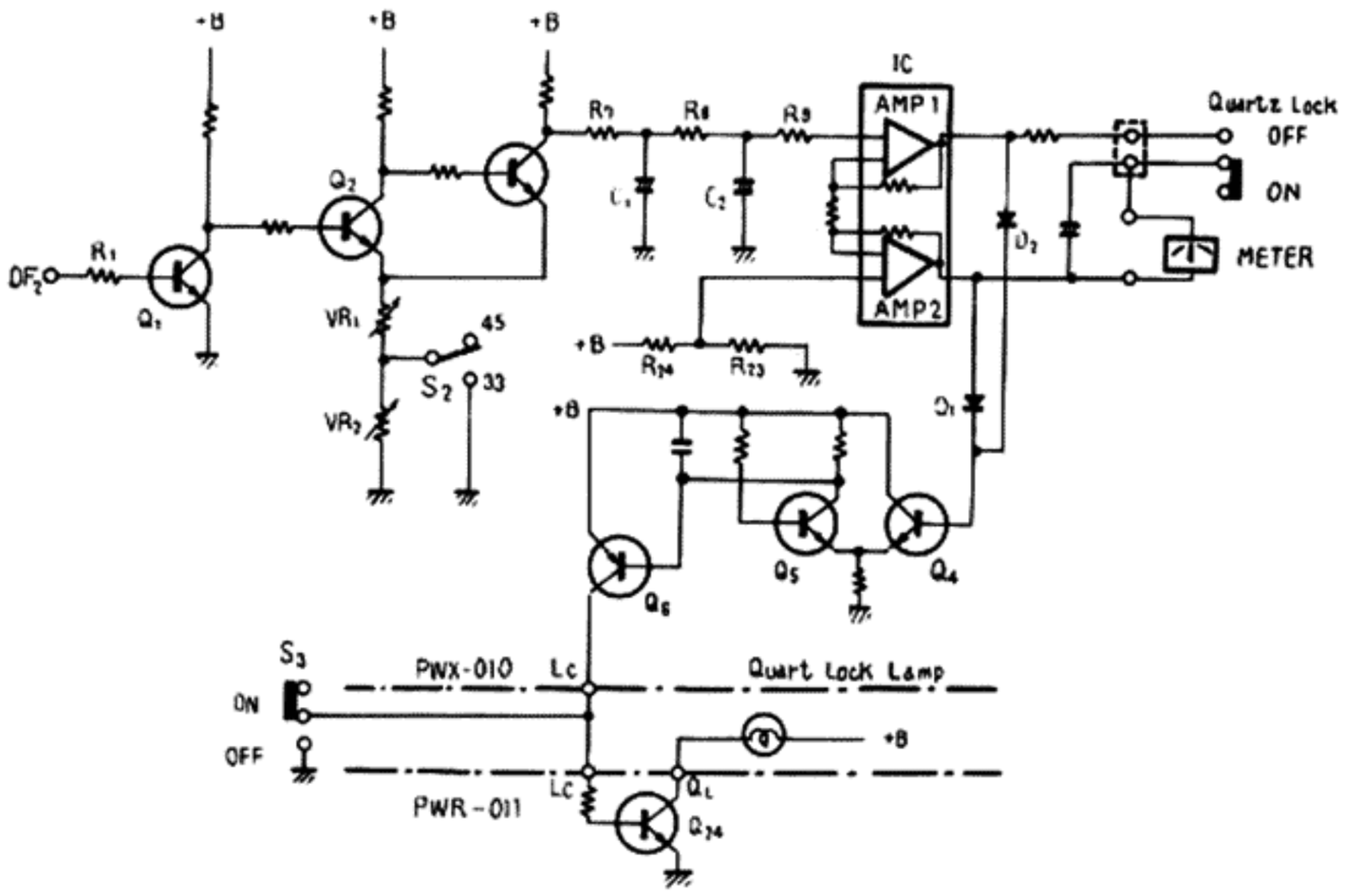


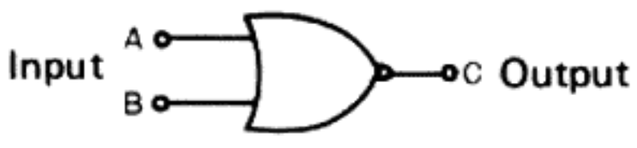
Fig. 3

3.2 START-STOP CONTROL SECTION (See Figs. 5, 6) (PWR-012)

This circuit plays an important role mainly when the turntable is stopped.
The turntable is completely stopped within 3/4 revolution after the STOP button has been pushed.

When POWER Switch Is Set to ON

1. The constant voltage circuit supplies +B voltage to transistors Q_7, $Q_{13} - Q_{18}$.
2. Charging current flows to C_{11} thru the route +B — C_{11} — R_{29} — R_{30}, Q_{15} is turned ON momentarily, the base potential of Q_{13} drops, Q_{13} is turned OFF, Q_{14} is turned ON, Q_7 is turned OFF, Q_8 is turned ON, and the constant voltage circuit consisting of Q_9 and Q_{10} is turned OFF.
3. When Q_9, Q_{10} are turned OFF, the supply of +B to PXM-051 is interrupted. Therefore, the turntable does not rotate.
4. Q_7, Q_8 constitute a logic circuit (OR circuit). This OR circuit is represented by the symbols shown in Fig. 4 below. The relationship between its input and output is shown in truth table.



Truth table

A	B	C
1	0	1
0	1	1
1	1	1
0	0	0

Fig. 4

*1 and 0 in this logic circuit represent:
"1": HIGH level
"0": LOW level
(A)(B)(C) in Fig. 5 are ABC in Fig. 4.

When START Button Is Pushed (ON)

1. When the START button is pushed, the collector of Q_{13} and the base of Q_{14} are grounded, flip-flop (FF) Q_{13}, Q_{14} is inverted, Q_{13} is turned ON and Q_{14} is turned OFF.
2. When Q_{14} is turned OFF, input A of the OR circuit consisting of Q_7, Q_8 becomes "1" (input B becomes "0") and the output becomes "1" and Q_9, Q_{10} are turned ON.
3. When Q_9, Q_{10} are turned ON, +B is supplied to PXM-051 and the meter circuit, and the turntable begins to rotate.
4. When the turntable begins to rotate, pulses having a frequency corresponding to the speed are applied to Q_1 from the OF_2 terminal in the PXM-051 drive control ass'y.
5. Q_1 is turned ON and OFF repeatedly by these pulses. When the turntable rotates at the rated speed, the collector potential (point A) of Q_1 drops, Q_2 of the Schmitt trigger circuit Q_2, Q_3 is turned OFF, Q_3 is turned ON and Q_5 is turned ON. When Q_5 is turned ON, input B of the OR circuit becomes "1" and +B to PWX-051 is interrupted as previously described.

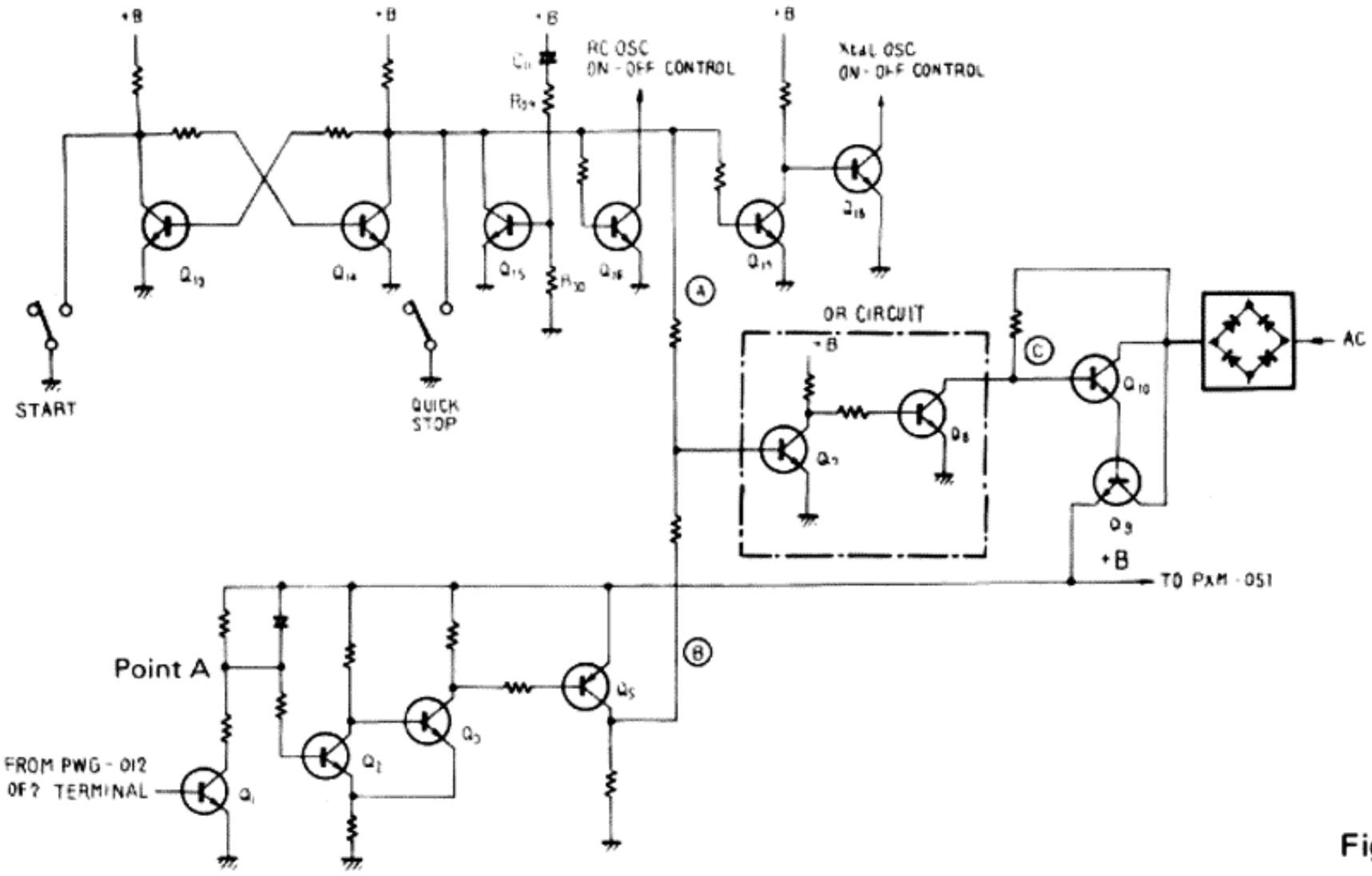


Fig. 5

6. When the turntable speed drops below the pre-set speed, this circuit inverts the Schmitt trigger circuit (Q_2 ON, Q_3 OFF), Q_5 is turned OFF and rotation of the turntable is halted.

When Quick STOP Button Is Pushed (ON)

1. When the STOP button is pushed, Q_{13} of FF Q_{13}, Q_{14} is turned OFF and Q_{14} is turned ON. However, Q_9, Q_{10} are not turned OFF even though Q_{14} is turned ON and the input of the OR circuit has become "1", the same as at POWER ON, because the OR circuit output remains "1" because input B of the OR circuit is made "1" by rotation of the turntable.
2. When Q_{14} is turned ON, Q_{16} is turned OFF, Q_{18} is turned ON, and the two reference frequency oscillation functions of the X'tal and RC in PXM-051 are disabled.
3. Since the reference frequency is not oscillated, the comparison control block in PXM-051 judges that the turntable is rotating at a speed higher than the rated speed and the direction judgement command block generates a reverse torque.
4. The speed of the turntable is quickly reduced by this reverse torque.
5. When the turntable speed drops to the pre-set speed, Q_1 is turned OFF, the collector potential of Q_1 (point A) rises, and the Schmitt trigger circuit Q_2, Q_3 is inverted (Q_2 ON, Q_3 OFF).
6. When Q_3 is turned OFF, Q_5 is also turned OFF and input B of the OR circuit becomes "0".
7. At this time, both inputs A and B of the OR circuit become 0 and output C also becomes 0.
8. When the output of the OR circuit becomes 0, Q_9, Q_{10} are turned OFF and the +B supply to PXM-051 is interrupted.
9. The turntable continues to rotate for a short time after the +B supply has been interrupted because of inertia.
10. The PXM-051 +B power supply consisting of Q_9, Q_{10} is turned OFF as described above when the two conditions "STOP button pushed" and "turntable speed lower than pre-set speed" are both satisfied.

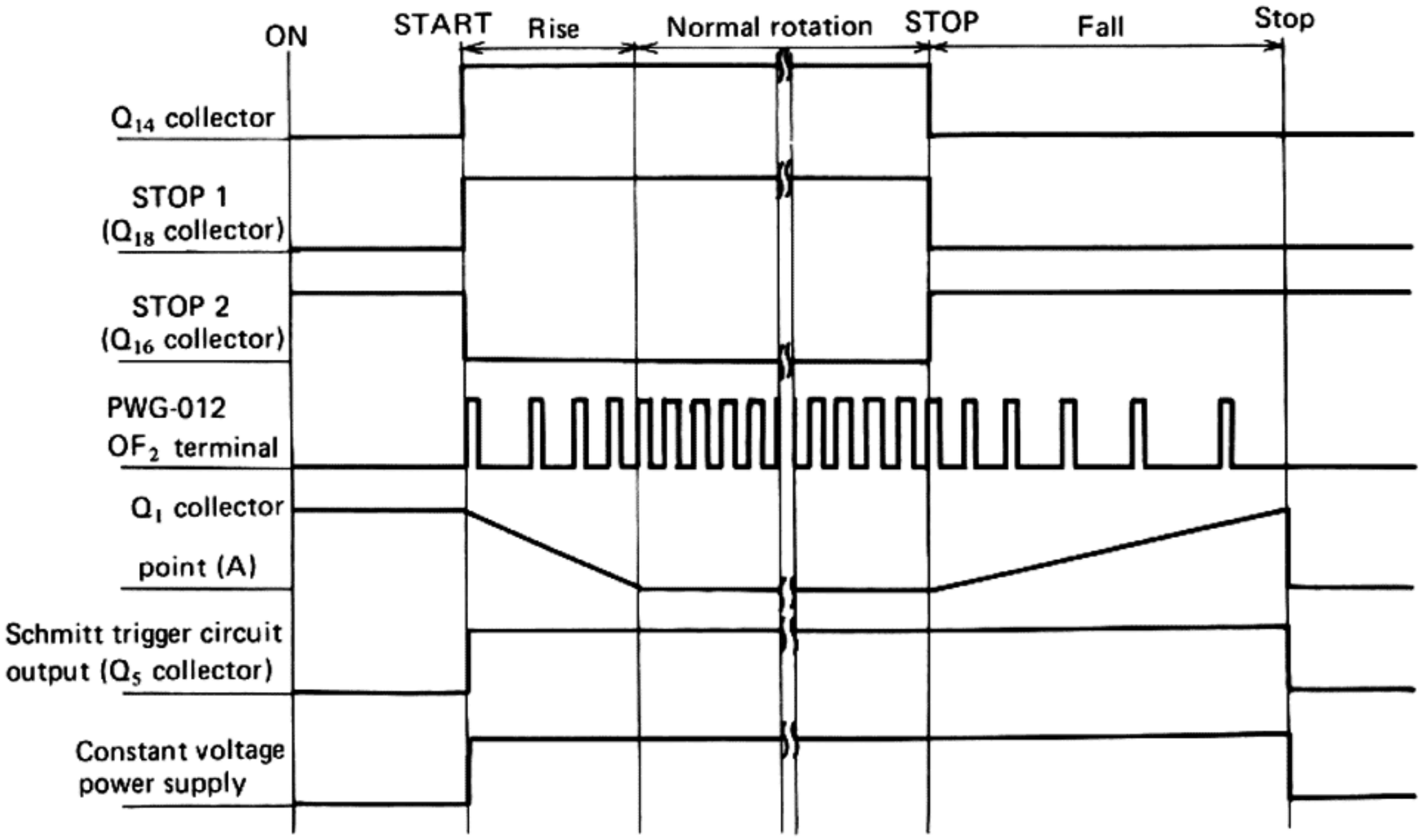


Fig. 6

4. ADJUSTMENTS

Follow the steps below.

4.1 PA2003 operating point adjustment
4.2 Meter 0 level adjustment
4.3 RC reference oscillation frequency
4.4 Quartz Lock OFF speed adjustment
4.5 Meter sensitivity adjustment

Remark.

1. Do not touch the trimmer capacitor (C_{13}) for adjusting X'tal reference frequency in the Drive Control Assembly (PWG-012) as it is pre-adjusted in the factory. If you have turned it by mistake or replaced int, set it at the mechanical center.
2. When adjusting on steps (4.1) and (4.4), remove a shorting connector (PXA-169) in the Drive Control Assembly (PWG-012) referring Fig. 7.
3. Even when Quartz Lock is ON the meter works if you short the pins in the Meter Drive Assembly (PWX-010) as Fig. 8.

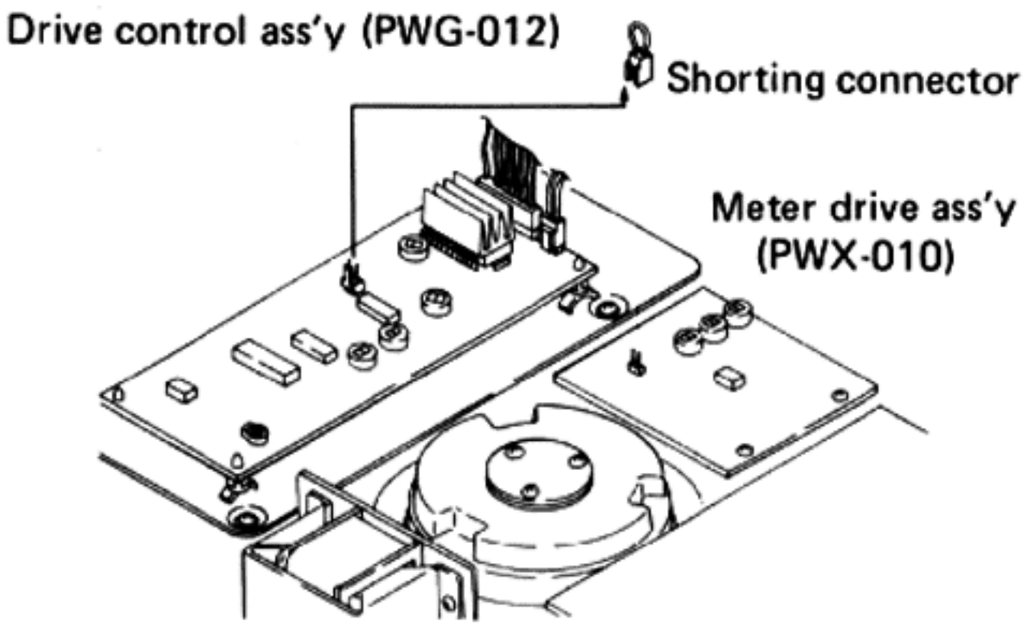


Fig. 7

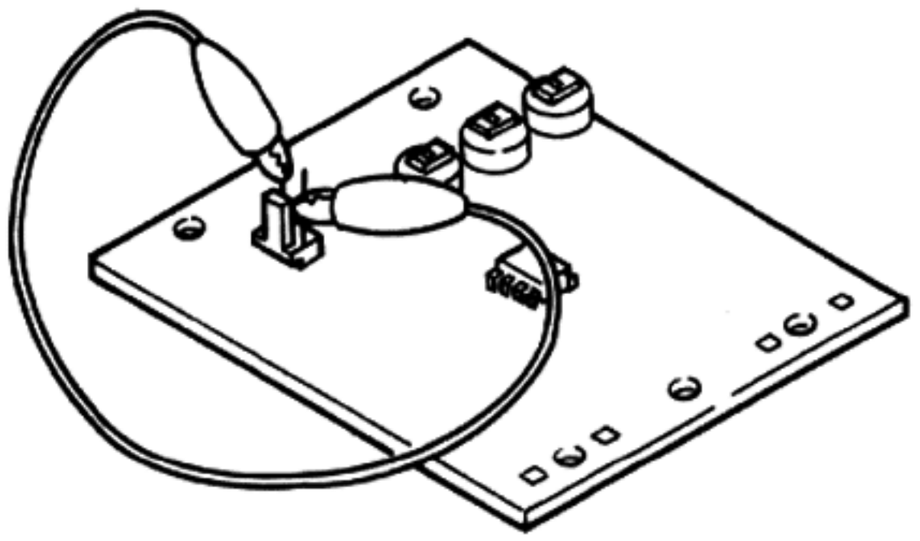


Fig. 8

Positions of adjustment VR

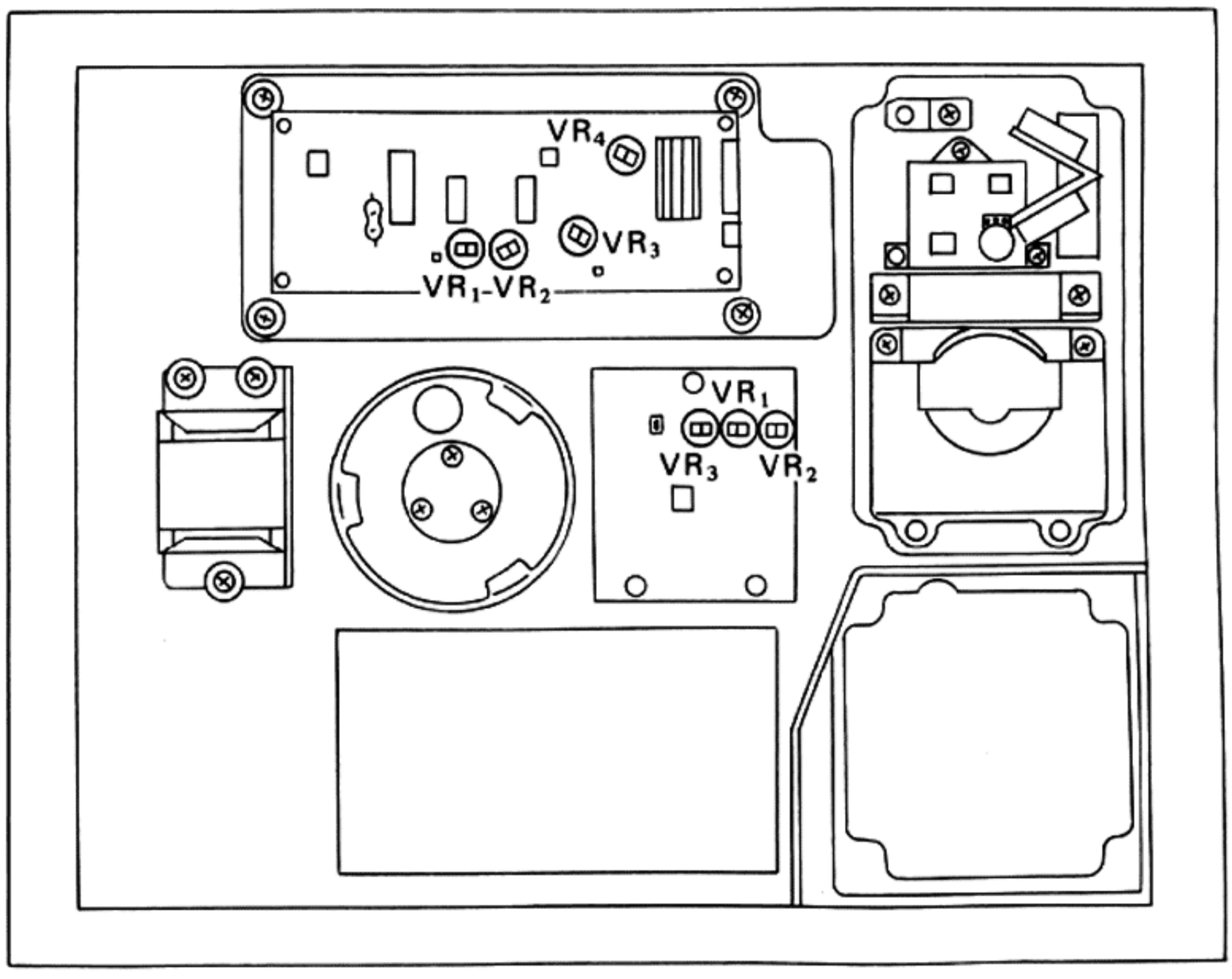


Fig. 9

4.1 IC=PA2003 OPERATING POINT ADJUSTMENT (Quartz Lock ON)

This adjustment must always be performed when PA2003, PD1001A have been replaced and when trouble in the loop filter or power supply circuit has been repaired.

1. Set to Quartz Lock ON and disconnect the shorting connector of the drive control ass'y (PWG-012).
2. Set the speed to 33rpm and place a strobe disc (GGK-067) onto the turntable. Adjust VR_4 (white) so that the strobe appears to be static.
3. When using a test record (3kHz), confirm that the center hole of the record is not eccentric relative to the center shaft of the turntable. Directly read the play output with a frequency counter (wow flutter meter) and adjust VR_4 for an output of 3000 ±5Hz.
4. Reconnect the shorting connector after adjustment.

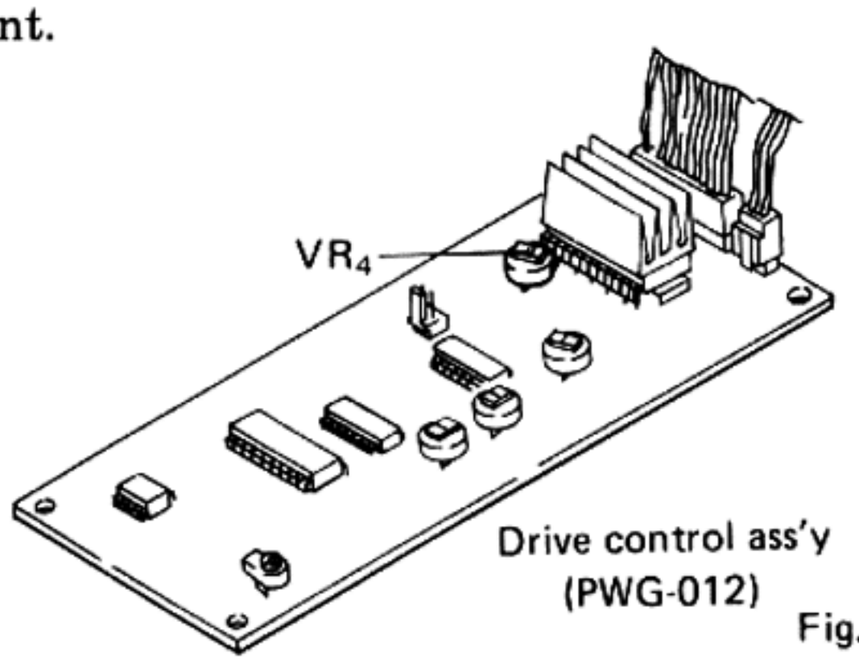


Fig. 10

4.2 METER 0 LEVEL ADJUSTMENT (Quartz Lock ON)

1. Short the shorting pins of the meter drive ass'y (PWX-010) so that the meter is operated even at Quartz Lock ON.
2. Set to Quartz Lock ON, 33rpm and adjust VR_1 of PWX-010 so that the pointer of the meter deflects to the center.
3. Switch the speed to 45rpm and adjust VR_2 so that the meter pointer deflects to the center.

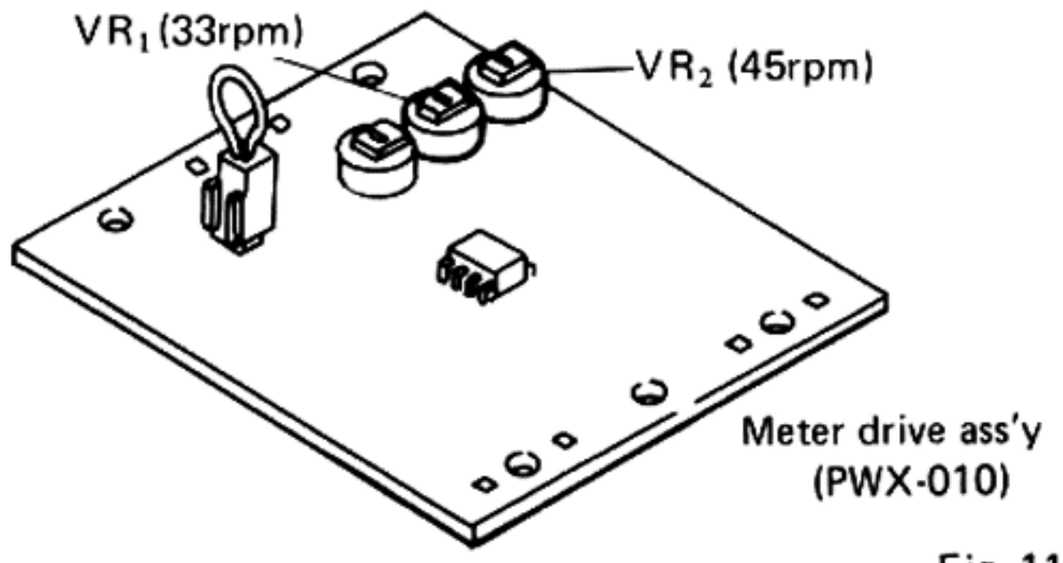


Fig. 11

4.3 RC REFERENCE OSCILLATION FREQUENCY ADJUSTMENT (Quartz Lock OFF)

1. Set the SPEED ADJ knob on the control panel to the mechanical center point.
2. Connect a frequency counter (wow/flutter meter) between terminal 21 of the drive control ass'y (PWG-012) and ground and set Quartz Lock to OFF.
3. Adjust the oscillation frequency to 6000 ±10Hz with VR_3 (blue) in PWG-012.

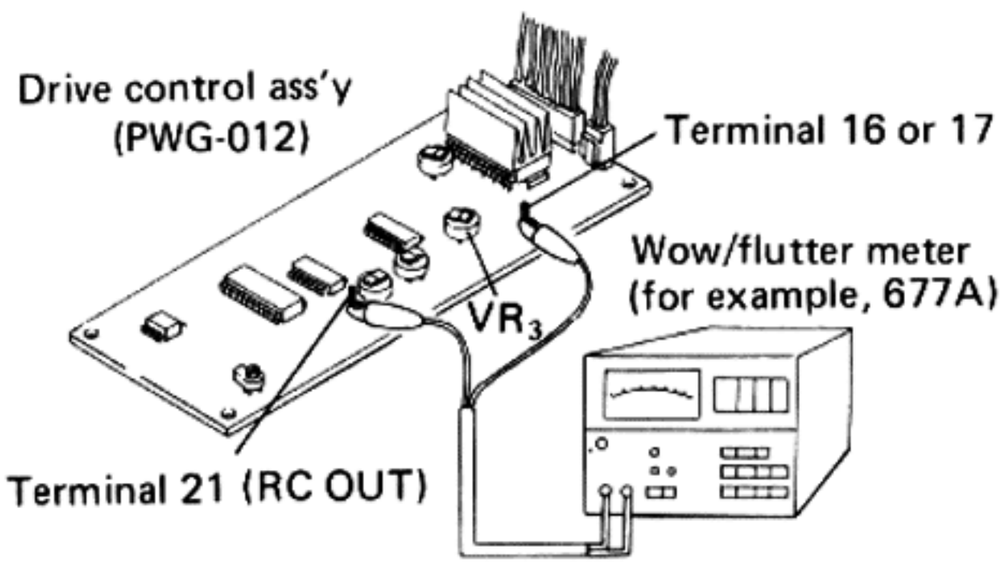


Fig. 12

4.4 QUARTZ LOCK OFF SPEED ADJUSTMENT

1. Disconnect the shorting connector of the drive control ass'y (PWG-012).
2. Turn the Quartz Lock switch ON-OFF with the SPEED ADJ knob at the mechanical center point.
   Adjust the VR on the drive control ass'y (PWG-012) so that there is no deviation in the deflection of the meter pointer at this time.

3. 33rpm adjuster VR_1
   *45rpm adjuster VR_2
   *Before beginning 45rpm adjustment, turn VR_2 fully clockwise and then turn it slowly counterclockwise and set it to the point at which there is no deviation in the deflection of the meter pointer. When VR_2 is turned further counterclockwise, there will be a point at which the meter pointer will again deflect to zero or near zero; however, this is not the correct speed. Neither does this indicate a faulty circuit.
4. When you cannot adjust them by VR_1 and VR_2, should be made by changing the resistance value R_{19} and R_{24}.
5. Reconnect the shorting connector after adjustment.

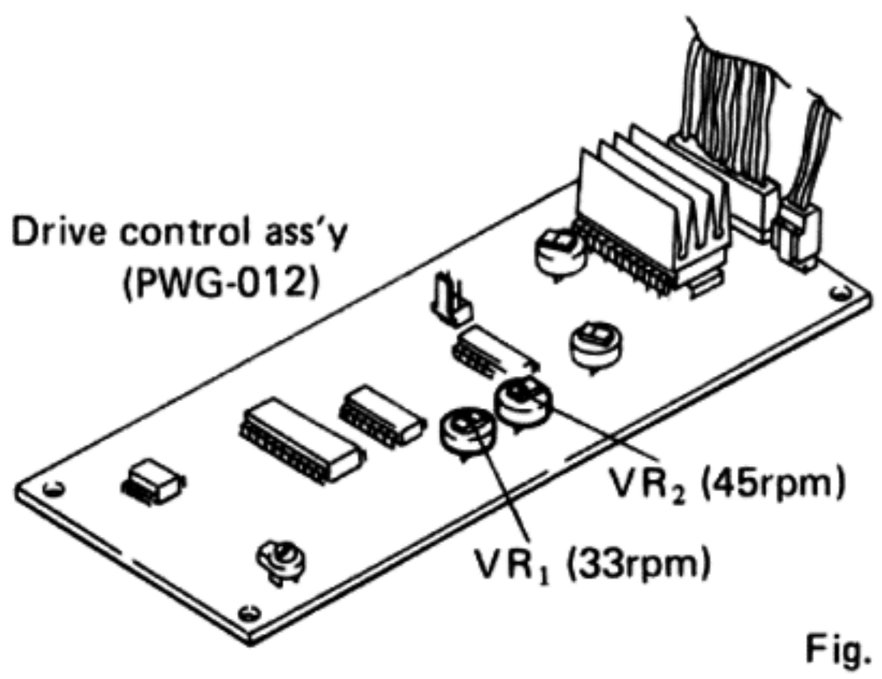


Fig. 13

4.5 METER SENSITIVITY ADJUSTMENT (Quartz Lock OFF)

1. Connect a frequency counter between terminal 21 of the drive control ass'y (PWG-012) and ground.
2. Adjust the oscillation frequency to 6360Hz by turning the SPEED ADJ knob clockwise.
3. Adjust VR_3 of the meter drive ass'y (PWX-010) and set at the position at which the meter pointer deflects to the +6% (#) position.
4. Turn the SPEED ADJ knob counterclockwise and confirm that the meter pointer deflects to the −6% (b) position when the oscillation frequency has been lowered to 5640Hz.

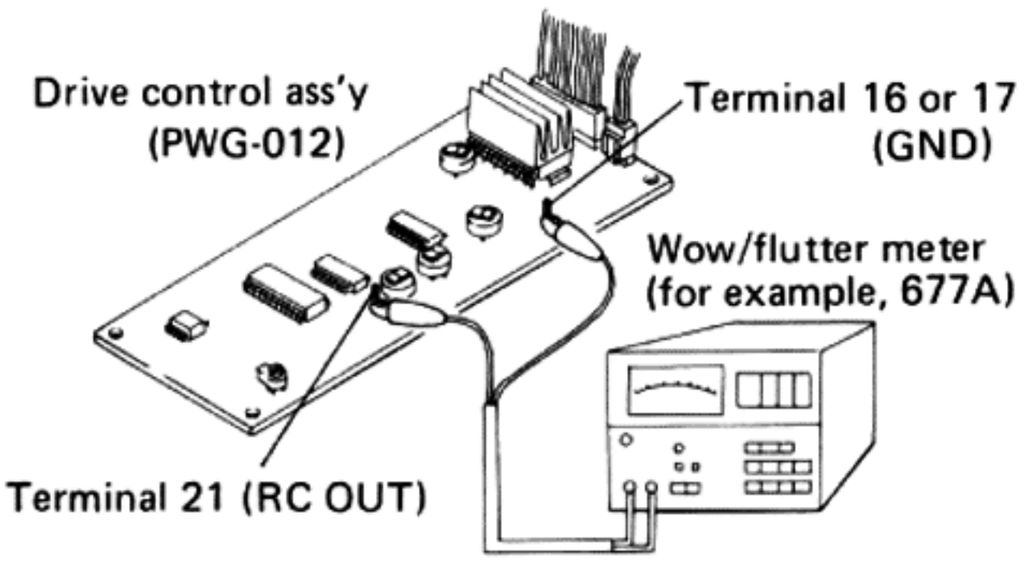


Fig. 14

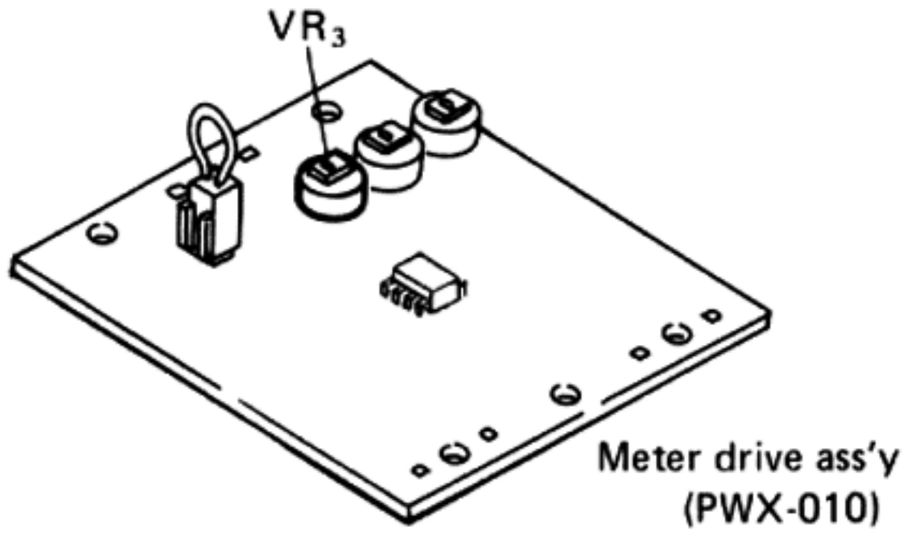
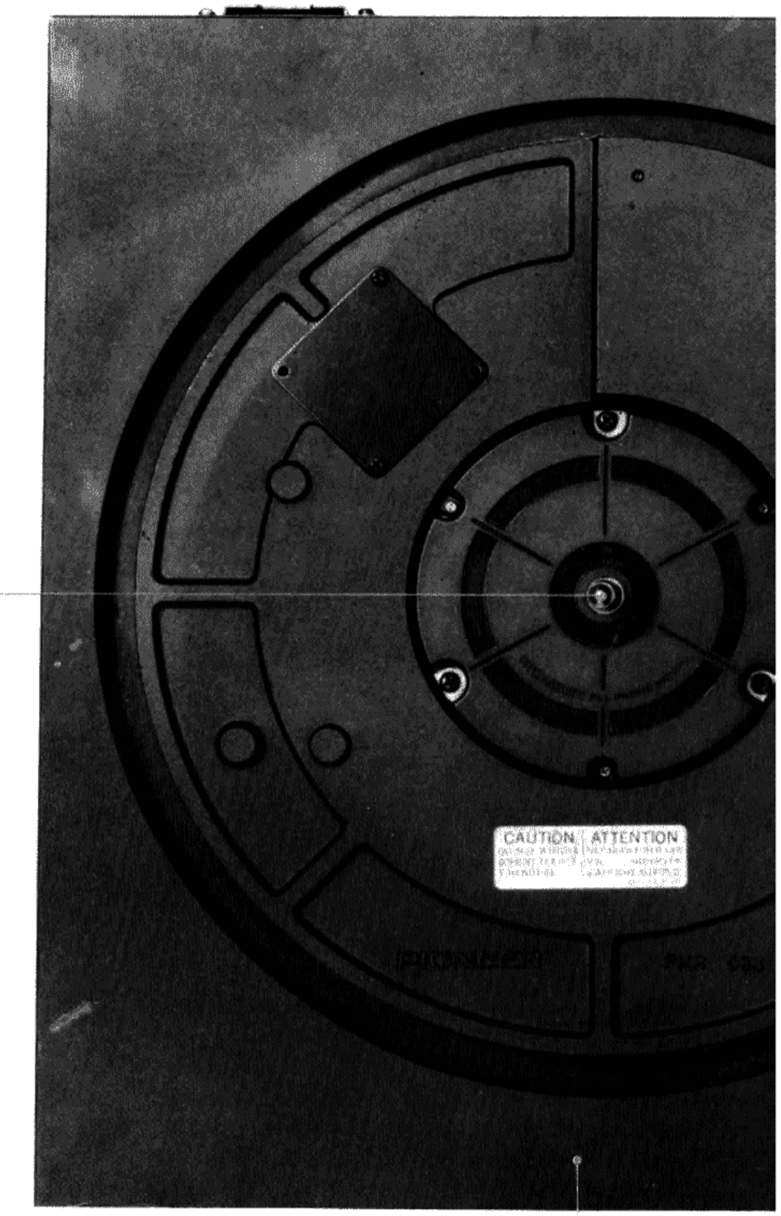


Fig. 15

NOTE
Disconnect the shorting connector of the meter drive ass'y (PWX-010) after adjustment.
After the turntable has stopped rotating at Quick STOP, it may turn a little counterclockwise due to the differences in the parts, etc. when the capacitor, resistors, or transistors (C_1, $R_2 - R_5$, Q_2, Q_3) on the power supply board ass'y (PWR-011) have been replaced to repair a failure. When this occurs, replace the part again so that the turntable does not rotate counterclockwise.

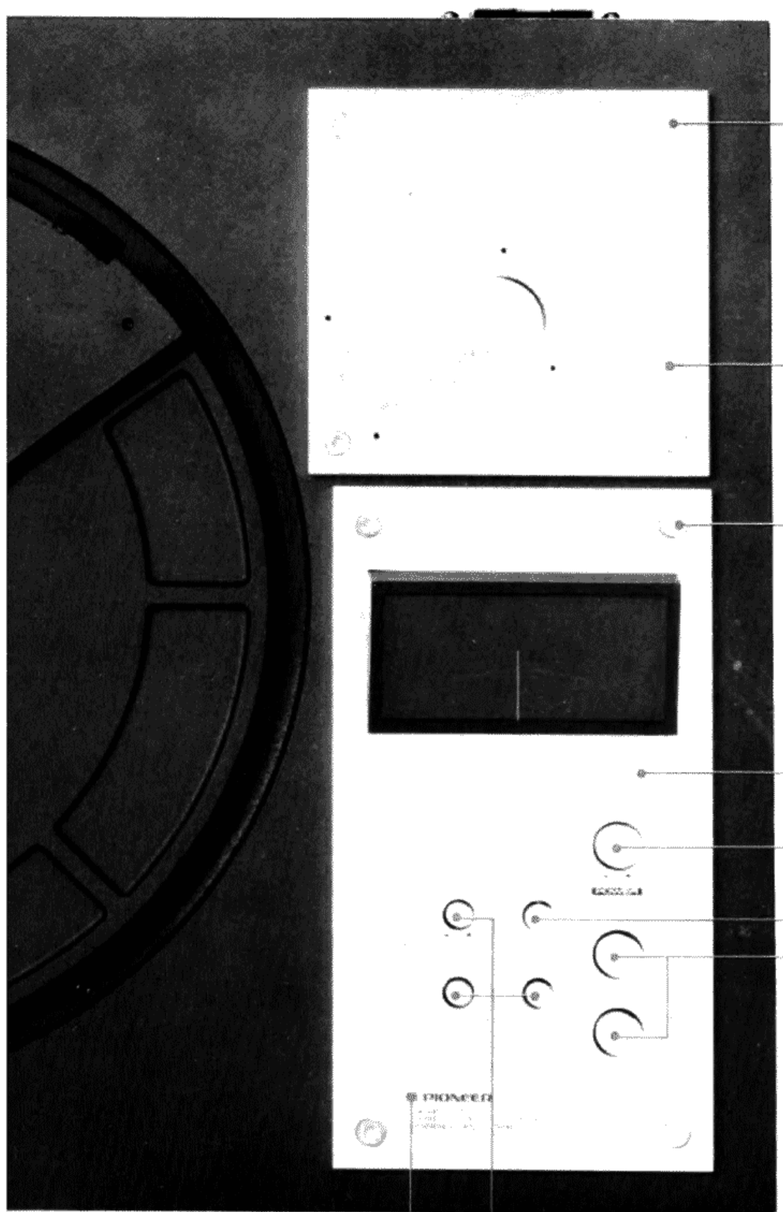
5. PARTS LOCATION

Top View



D.D Motor
PXA-352

Panel
PNR-045



Screw
PBA-052

SME-3009/II alumi panel
PAT-032

Screw
PBA-046

Control panel
PAT-034

Button unit
PXT-127

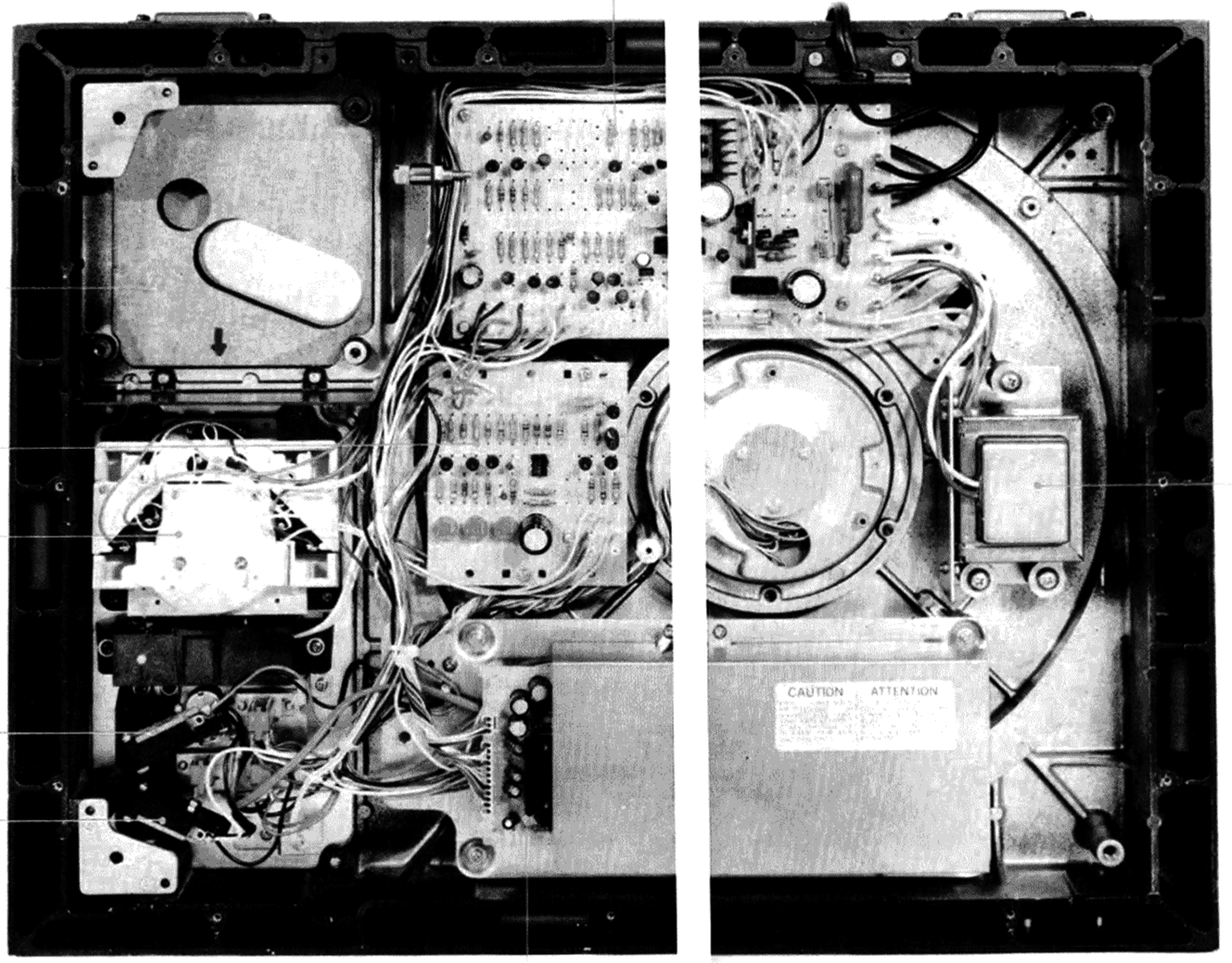
Knob
PAA-009

Button unit
PXT-129

Lens
PNW-293

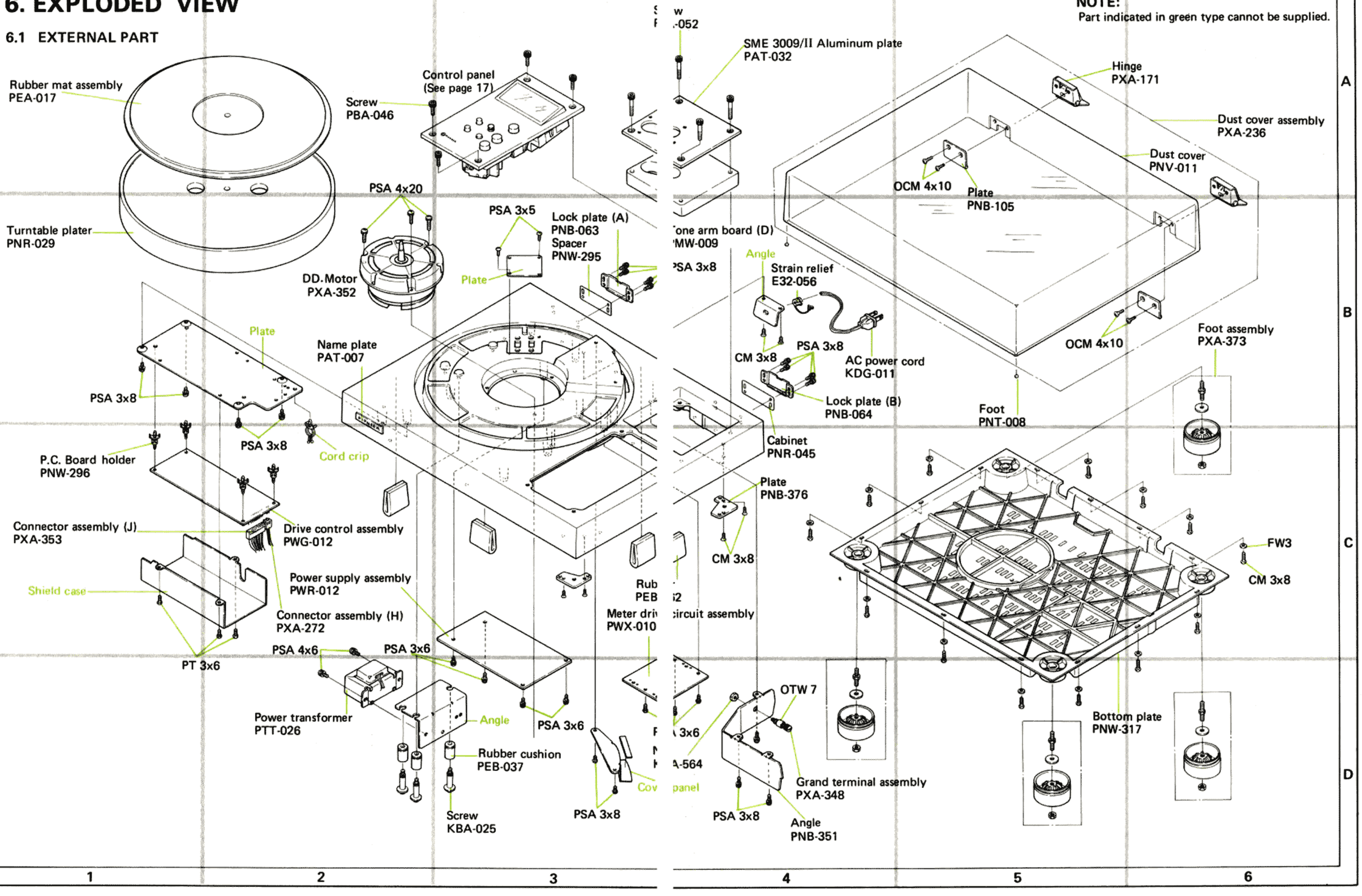
Konb
PAD-020

Bottom View


Power supply asse ly
PWR-012
Tone arm mounting board (D)
PMW-009
Meter drive circuit assembly
PWX-010
Meter assembly
PAW-001
Microswitch
KSF-016
Microswitch
PSF-023
Power transformer
PTT-026
CAUTION ATTENTION
Drive control assembly
PWG-012

6. EXPLODED VIEW

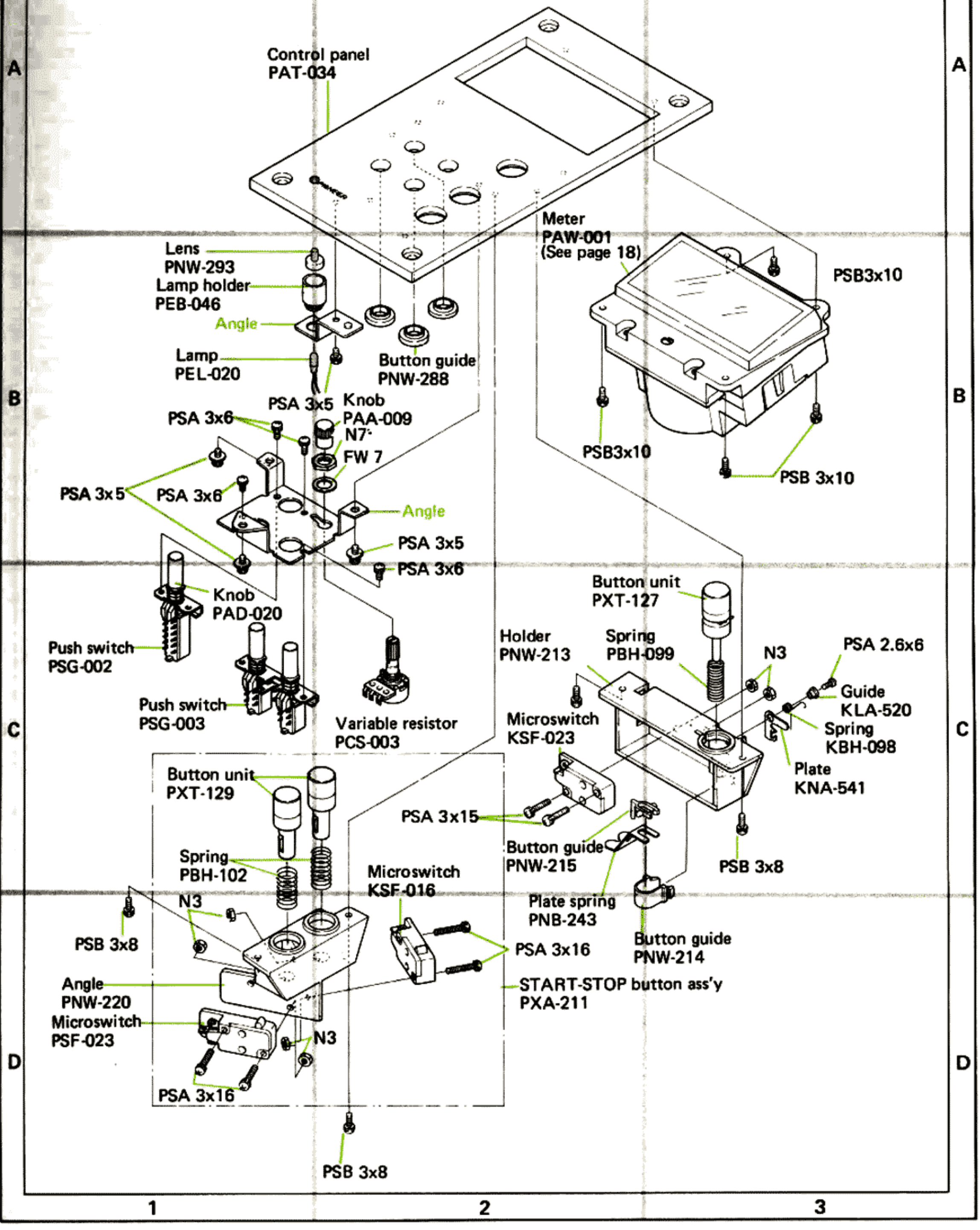
6.1 EXTERNAL PART



NOTE:
Part indicated in green type cannot be supplied.

6.2 CONTROL PANEL

NOTE:
Parts indicated in green type cannot be supplied.



6.3 METER

NOTE:
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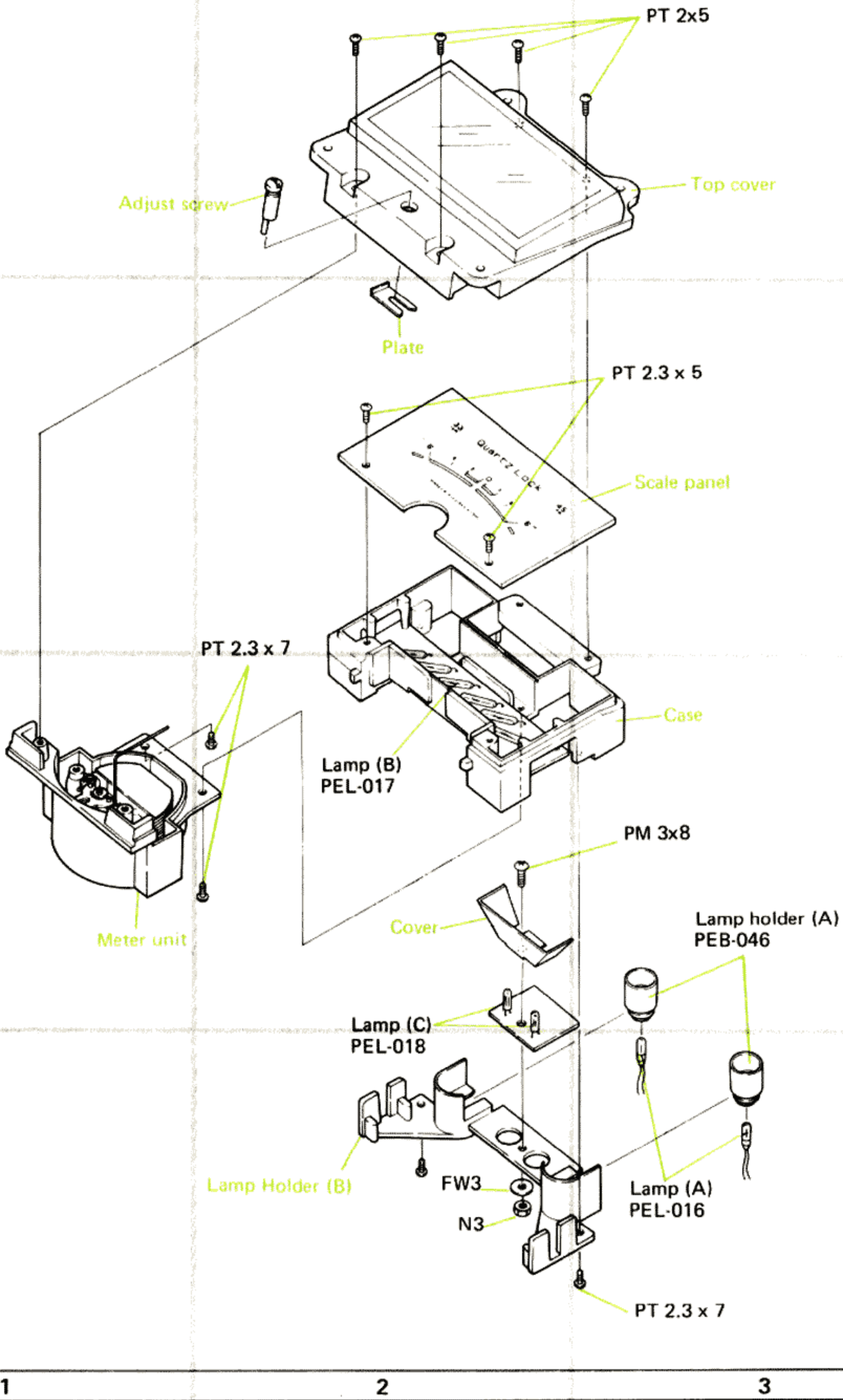
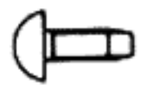
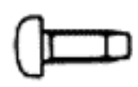
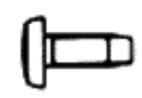
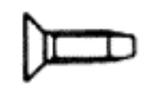
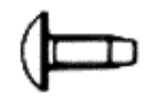
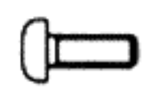
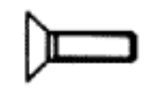
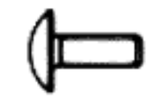
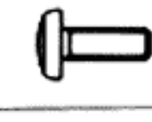
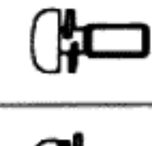
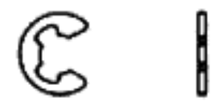
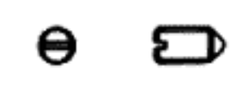
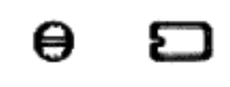
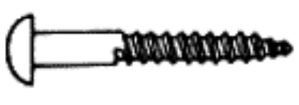


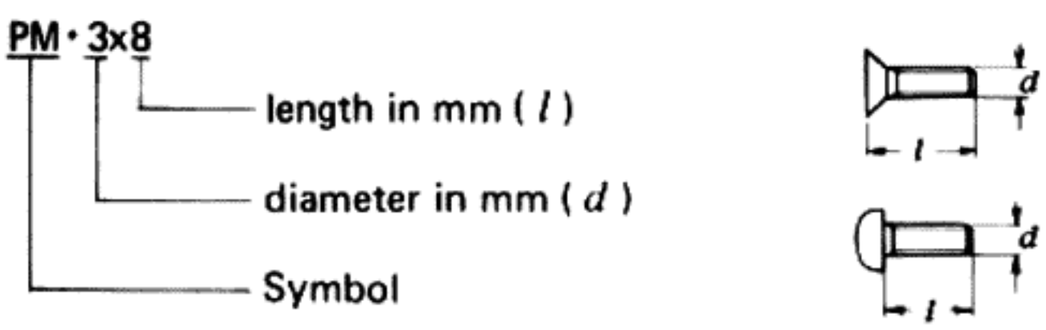
Nomenclature of Screws, Washers and Nuts.

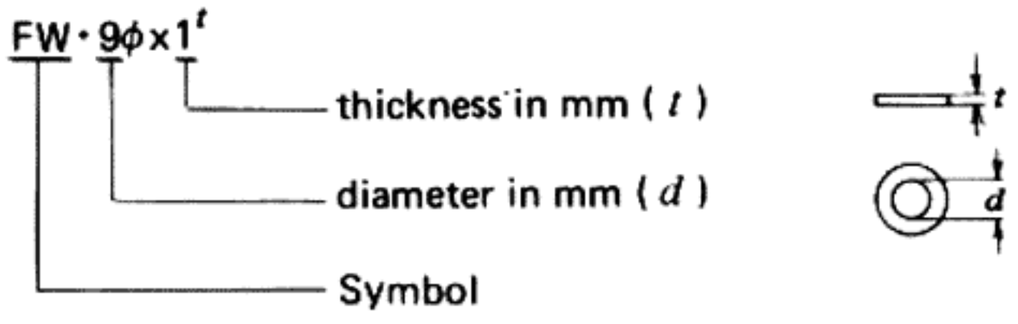
The following symbols stand for screws, washers and nuts as shown in exploded view.

Symbol	Description	Shape
RT	Brazier head tapping screw	
PT	Pan head tapping screw	
BT	Binding head tapping screw	
CT	Countersunk head tapping screw	
TT	Truss head tapping screw	
OCT	Oval countersunk head tapping screw	
PM	Pan head machine screw	
CM	Countersunk head machine screw	
OCM	Oval countersunk head machine screw	
TM	Truss head machine screw	
BM	Binding head machine screw	
PSA	Pan head screw with spring lock washer	
PSB	Pan head screw with spring lock washer and flat washer	
PSF	Pan head screw with flat washer	

Symbol	Description	Shape
EW	E type washer	
FW	Flat washer	
SW	Spring lock washer	
N	Nut	
WN	Washer faced nut	
ITW	Internal toothed lock washer	
OTW	Outernal toothed lock washer	
SC	Slotted set screw (Cone point)	
SF	Slotted set screw (Flat point)	
HS	Hexagon socket headless set screw	
OCW	Oval countersunk head wood screw	
CW	Countersunk head wood screw	
RW	Round head wood screw	

EXAMPLE





7. SCHEMATIC DIAGRAMS P.C. BOARD PATTERNS AND PARTS LIST

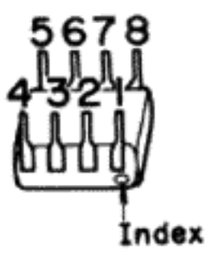
7.1 MISCELLANEA PART

NOTE:
- *Capacitors: in μF unless otherwise noted p:pF*
- *Resistors: in Ω, ¼W unless otherwise noted k:kΩ, M:MΩ*

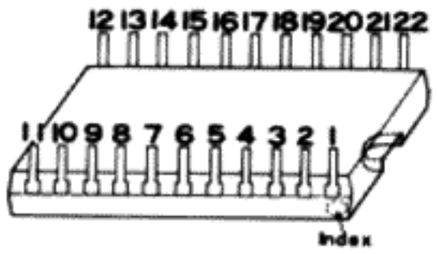
Symbol	Description	Part No.
	Drive control assembly	PWG-012
	Positinal detector assembly	PWX-006
	Power supply assembly	PWR-012
	Meter drive circuit assembly	PWX-010
	SPEED ADJ 10k-B	PCS-003
S1	Microswitch (POWER)	KSF-023
S2	Push switch (SPEED)	PSG-003
S3	Push switch (Quartz Lock)	PSG-002
S4	Microswitch (START)	KSF-016
S5	Microswitch (STOP)	PSF-023
	Meter assembly	PAW-001
	Pilot lamp 8V 50mA (POWER)	PEL-020
	Power transfomer	PTT-026

External Appearance of Transistors

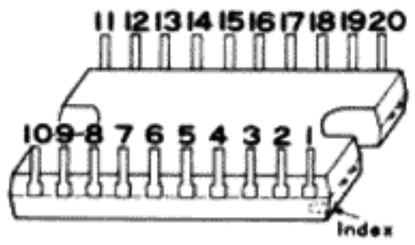
NJM4558DA



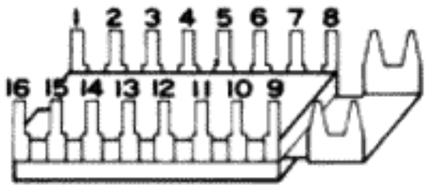
PD1001A



PA2003

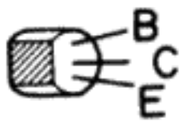


TC4001P

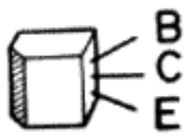


2SA495
2SC372

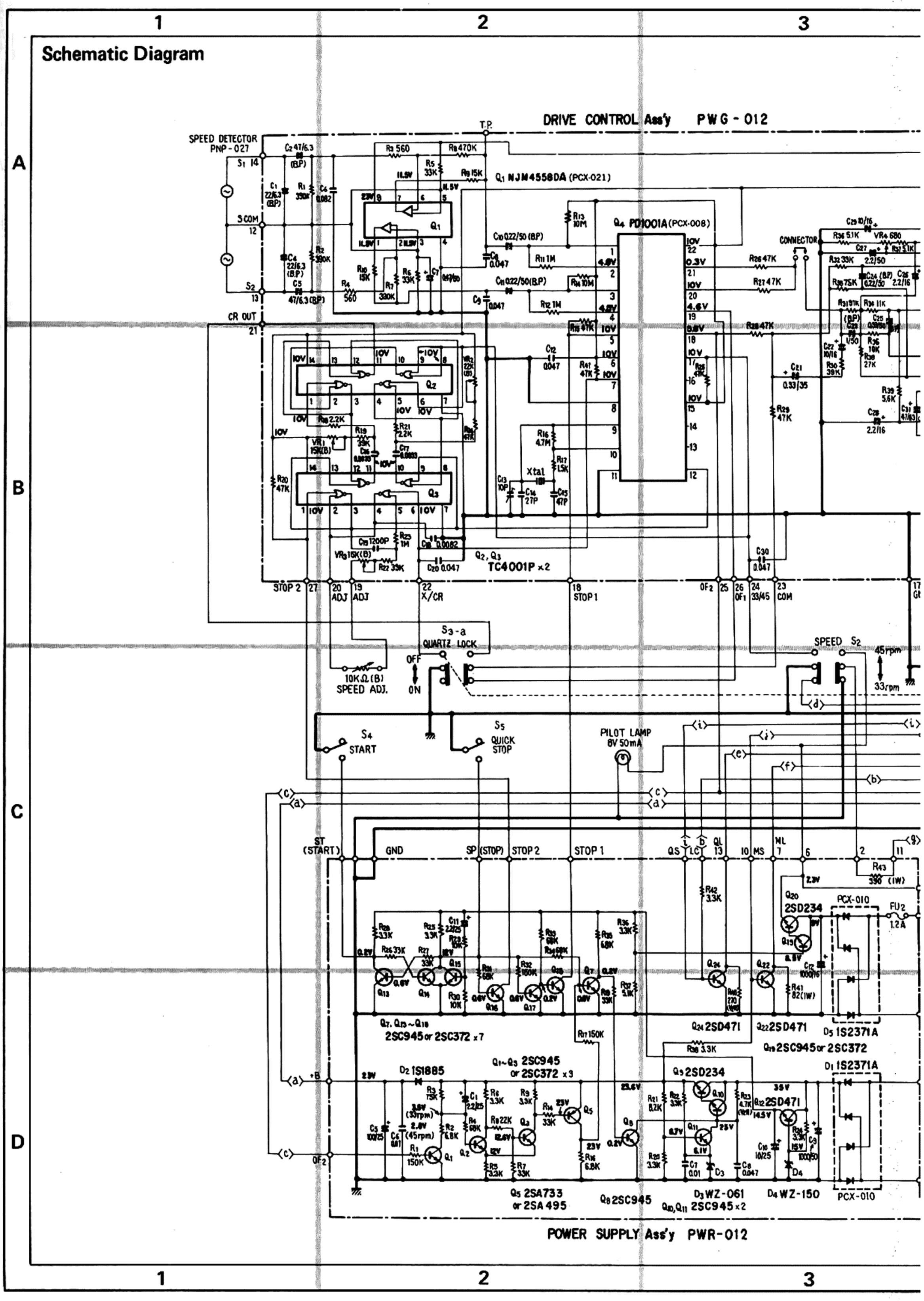
2SA733
2SC945



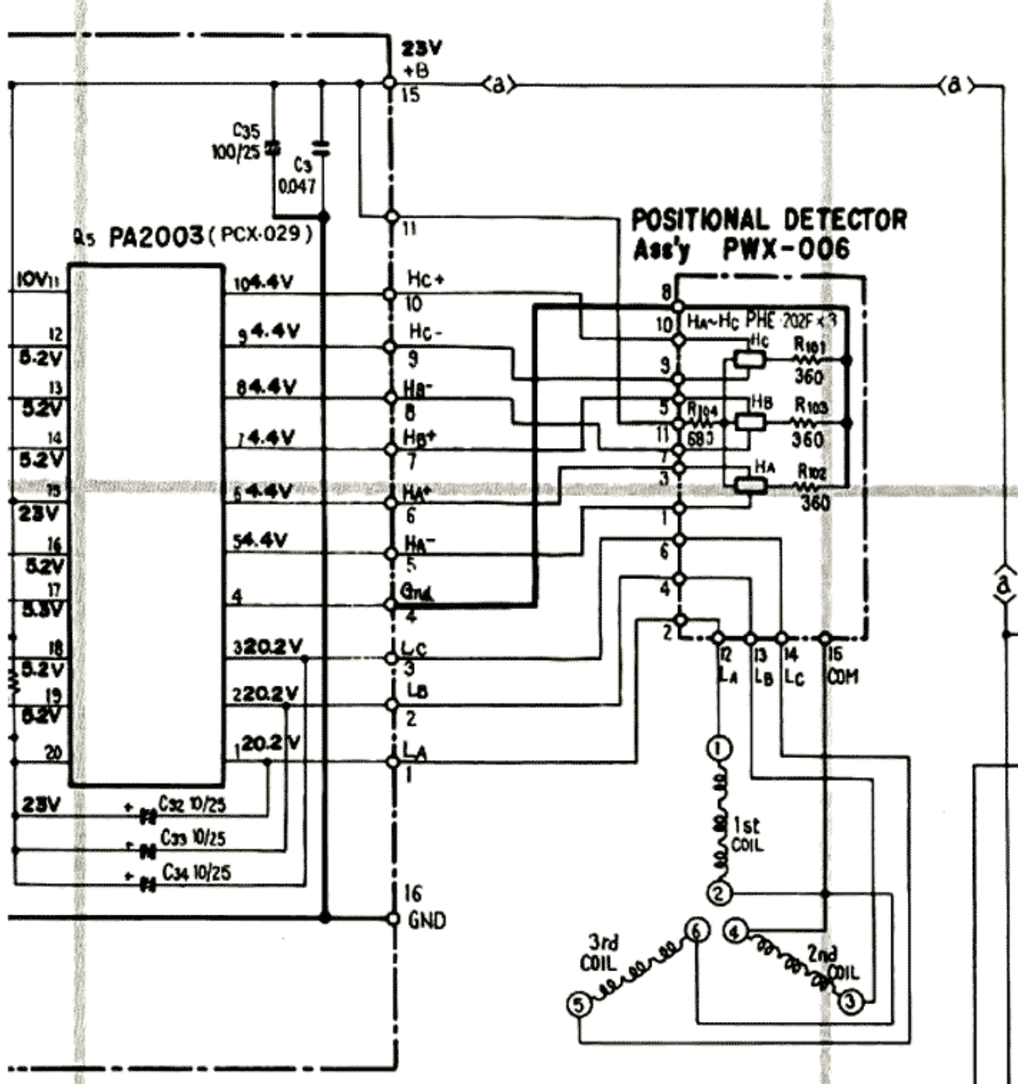
2SD471

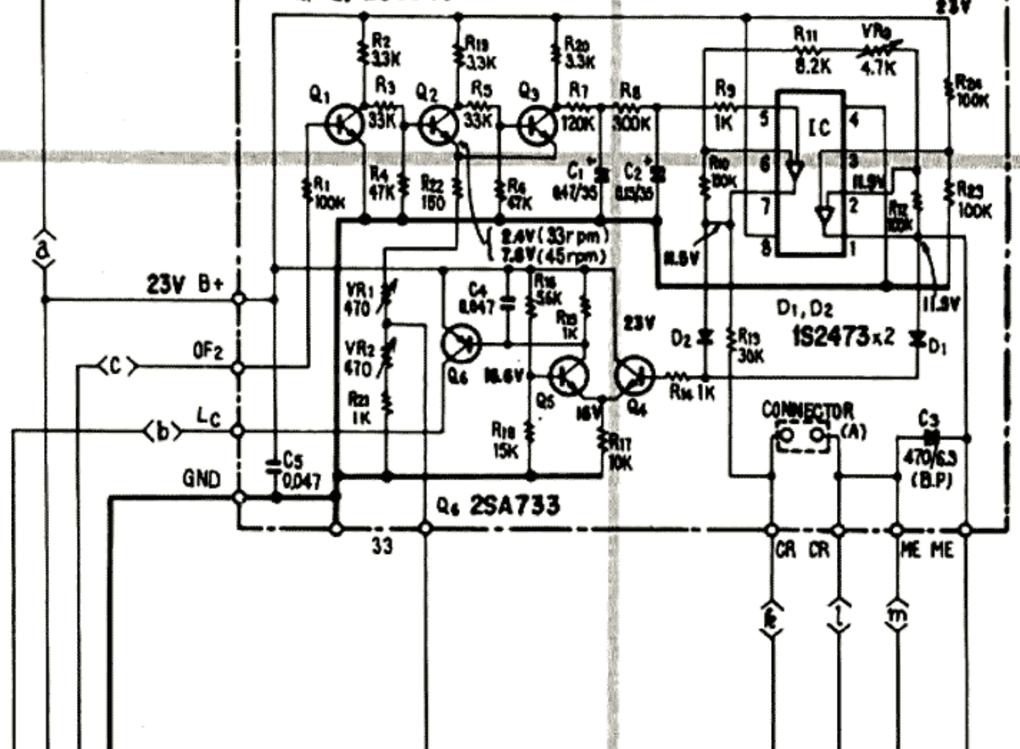


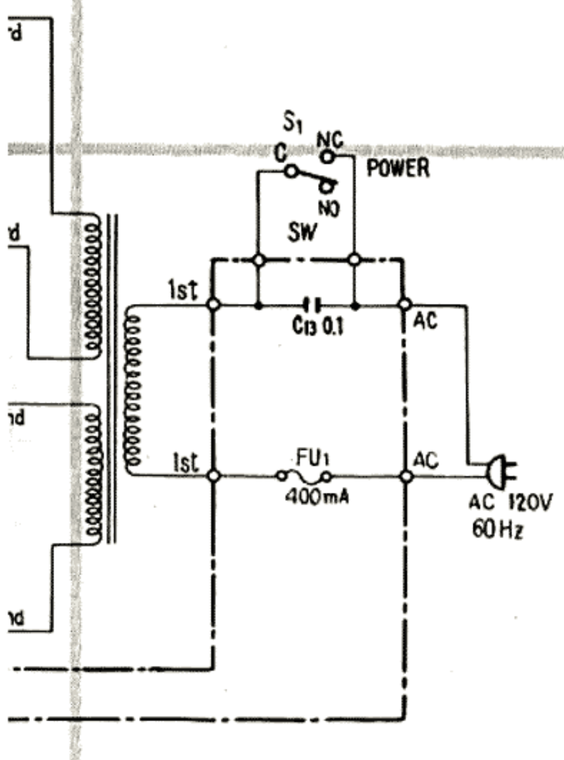
Schematic Diagram



NOTE:
The indicated semiconductors are representative ones only. Other alternative semiconductors may be used and are listed in the parts lists.







SWITCHES:
S_1 : POWER
OFF — ON

S_2 : SPEED SELECTOR
33rpm — 45 rpm

S_3 : QUARTZ LOCK
OFF — ON

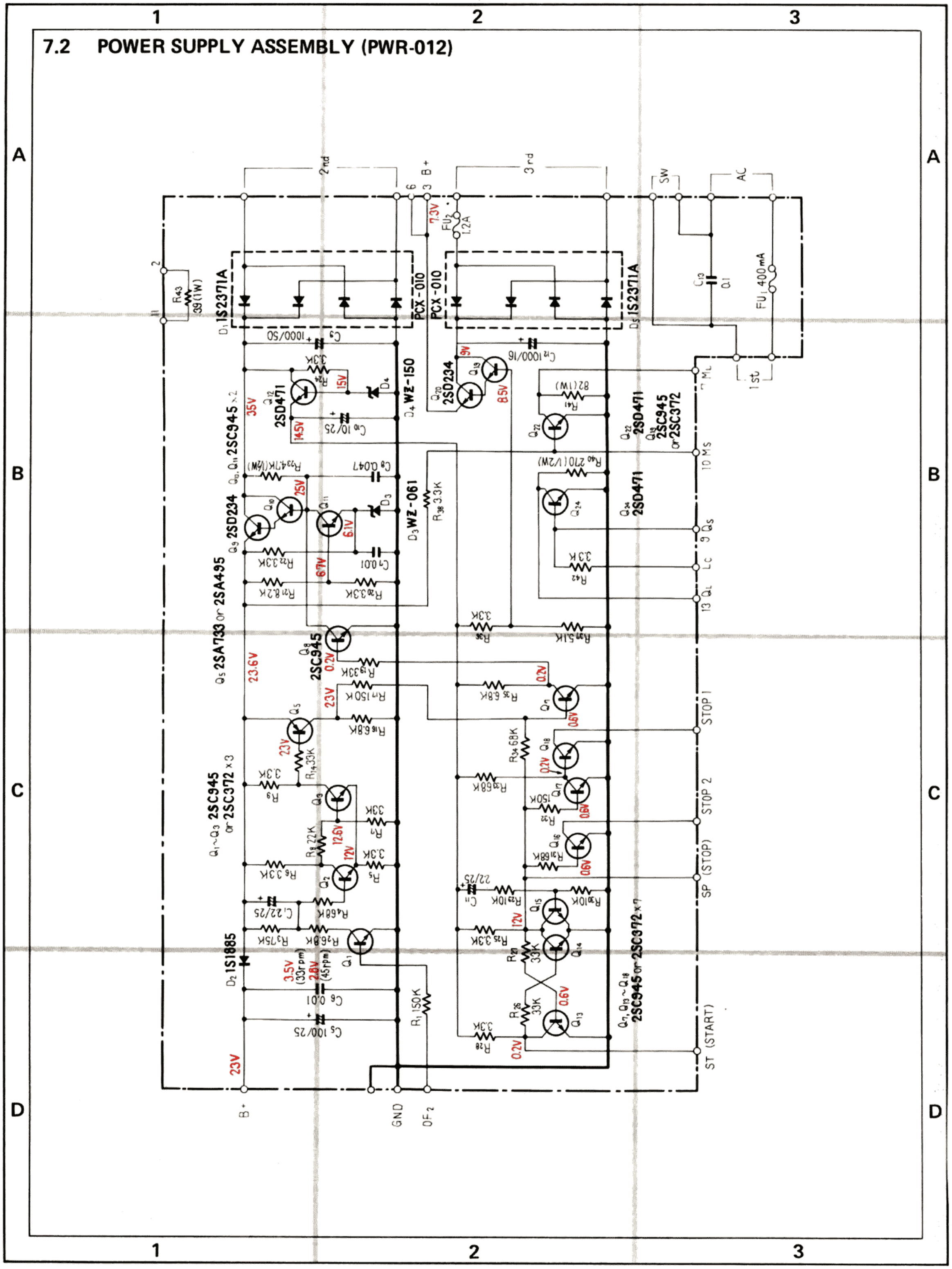
S_4 : START
OFF — ON

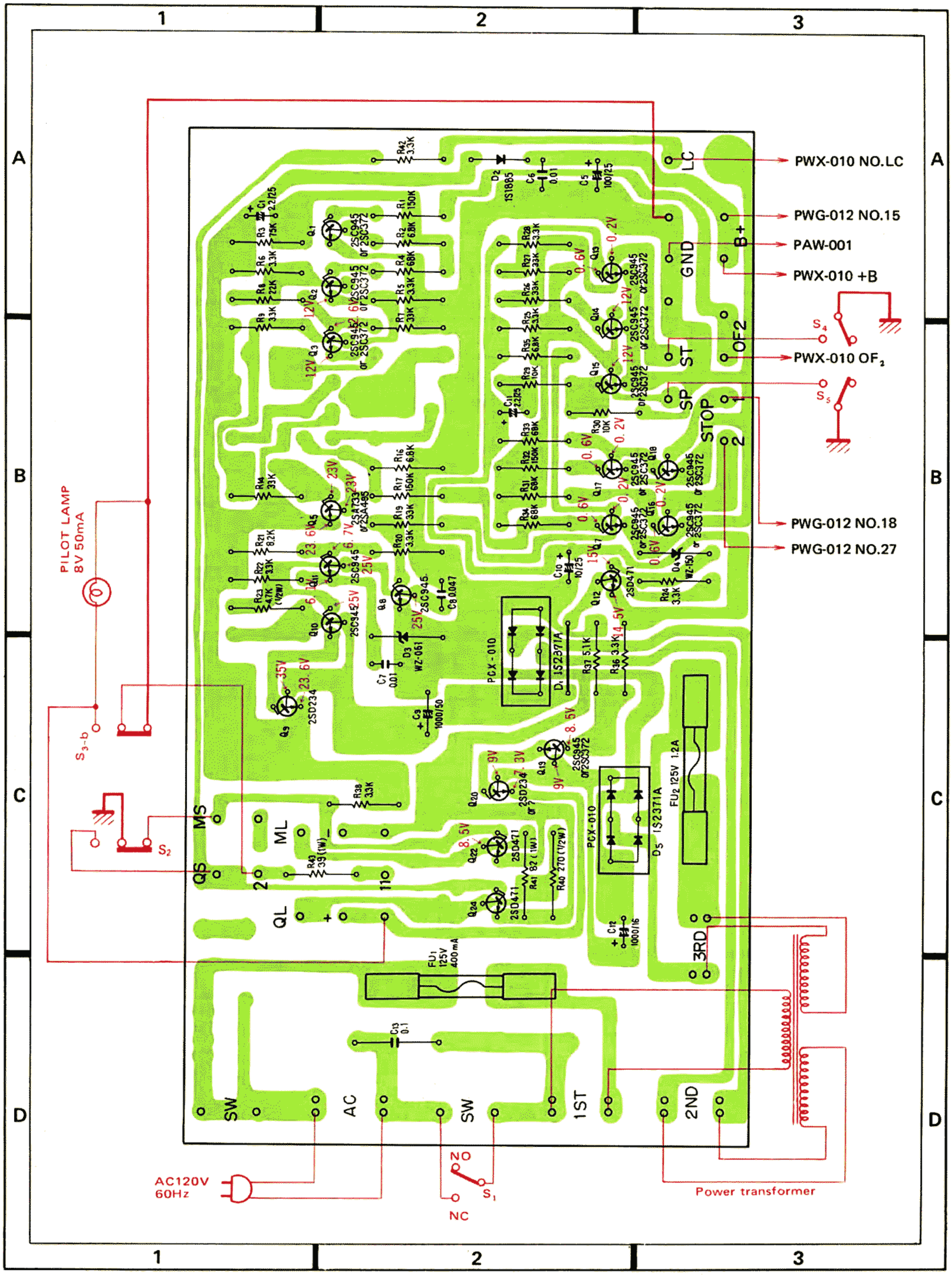
S_5 : QUICK STOP
OFF — ON

RESISTORS :
IN OHM, 1/4W, ±5% TOLERANCE UNLESS OTHERWISE NOTED. K : kΩ M : MΩ

CAPACITORS :
IN μF UNLESS OTHERWISE NOTED P : pF

7.2 POWER SUPPLY ASSEMBLY (PWR-012)




PWX-010 NO.LC
PWG-012 NO.15
PAW-001
PWX-010 +B
PWX-010 OF2
PWG-012 NO.18
PWG-012 NO.27
PILOT LAMP
8V 50mA
AC120V
60Hz
NO
NC
Power transformer
LC
GND
B+
ST
OF2
SP
STOP
MS
ML
QS
QL
SW
AC
1ST
2ND
3RD
PCX-010
D1 1S2371A
D5 1S2371A
FU1 125V 400mA
FU2 125V 1.2A
2SC945 or 2SC372
2SA733 or 2SA495
2SD234 or 2SD313
2SD471
WZ-061
WZ-150
1S1885
2SD471

Part List of Power Supply Assembly (PWR-012)

SEMICONDUCTORS

Symbol	Description	Part No.
Q1	Transistor	2SC945-P or Q (2SC372-Y)
Q2	Transistor	2SC945-P or Q (2SC372-Y
Q3	Transistor	2SC945-P or Q (2SC372-Y)
Q5	Transistor	2SA733-P or Q (2SA495-Y)
Q7	Transistor	2SC945-P or Q (2SC372-Y)
Q8	Transistor	2SC945-P or Q
Q9	Transistor	2SD234
Q10	Transistor	2SC945-P or Q
Q11	Transistor	2SC945-P or Q
Q12	Transistor	2SD471
Q13	Transistor	2SC945-P or Q (2SC372-Y)
Q14	Transistor	2SC945-P or Q (2SC372-Y)
Q15	Transistor	2SC945-P or Q (2SC372-Y)
Q16	Transistor	2SC945-P or Q (2SC372-Y)
Q17	Transistor	2SC945-P or Q (2SC372-Y)
Q18	Transistor	2SC945-P or Q (2SC372-Y)
Q19	Transistor	2SC945-P or Q (2SC372-Y)
Q20	Transistor	2SD234
Q22	Transistor	2SD471
Q24	Transistor	2SD471
D1	Bridge rectifiers	PCX-010
D2	Diode	1S1885
D3	Zener diode	WZ-061
D4	Zener diode	WZ-150
D5	Bridge rectifiers	PCX-010

RESISTORS

Symbol	Description		Part No.
R1	Carbon film	150k	RD¼PS 154J
R2	Metal film	6.8k	RN¼PR 6801G
R3	Metal film	75k	RN¼PR 7502G
R4	Metal film	68k	RN¼PR 6802G
R5	Metal film	3.3k	RN¼PR 3301G
R6	Carbon film	3.3k	RD¼PS 332J
R7	Carbon film	33k	RD¼PS 333J
R8	Carbon film	22k	RD¼PS 223J
R9	Carbon film	23k	RD¼PS 323J
R14	Carbon film	33k	RD¼PS 333J
R16	Carbon film	6.8k	RD¼PS 682J
R17	Carbon film	150k	RD¼PS 154J
R19	Carbon film	33k	RD¼PS 333J
R20	Carbon film	32k	RD¼PS 323J
R21	Carbon film	8.2k	RD¼PS 822J
R22	Carbon film	32k	RD¼PS 323J
R23	Carbon film	4.7k	RD½PS 472J
R24	Carbon film	32k	RD¼PS 323J
R25	Carbon film	32k	RD¼PS 323J
R26	Carbon film	33k	RD¼PS 333J
R27	Carbon film	33k	RD¼PS 333J
R28	Carbon film	32k	RD¼PS 323J
R29	Carbon film	10k	RD¼PS 103J
R30	Carbon film	10k	RD¼PS 103J
R31	Carbon film	68k	RD¼PS 683J
R32	Carbon film	150k	RD¼PS 154J
R33	Carbon film	68k	RD¼PS 683J
R34	Carbon film	68k	RD¼PS 683J
R35	Carbon film	6.8k	RD¼PS 682J
R36	Carbon film	33k	RD¼PS 332J
R37	Carbon film	5.1k	RD¼PS 512J
R38	Carbon film	3.3k	RD¼PS 332J
R40	Carbon film	270	RD½PS 271J
R41	Metal oxide	82	RS1P 820J
R42	Carbon film	3.3k	RD¼PS 332J
R43	Metal oxide	39	RS1P 390J

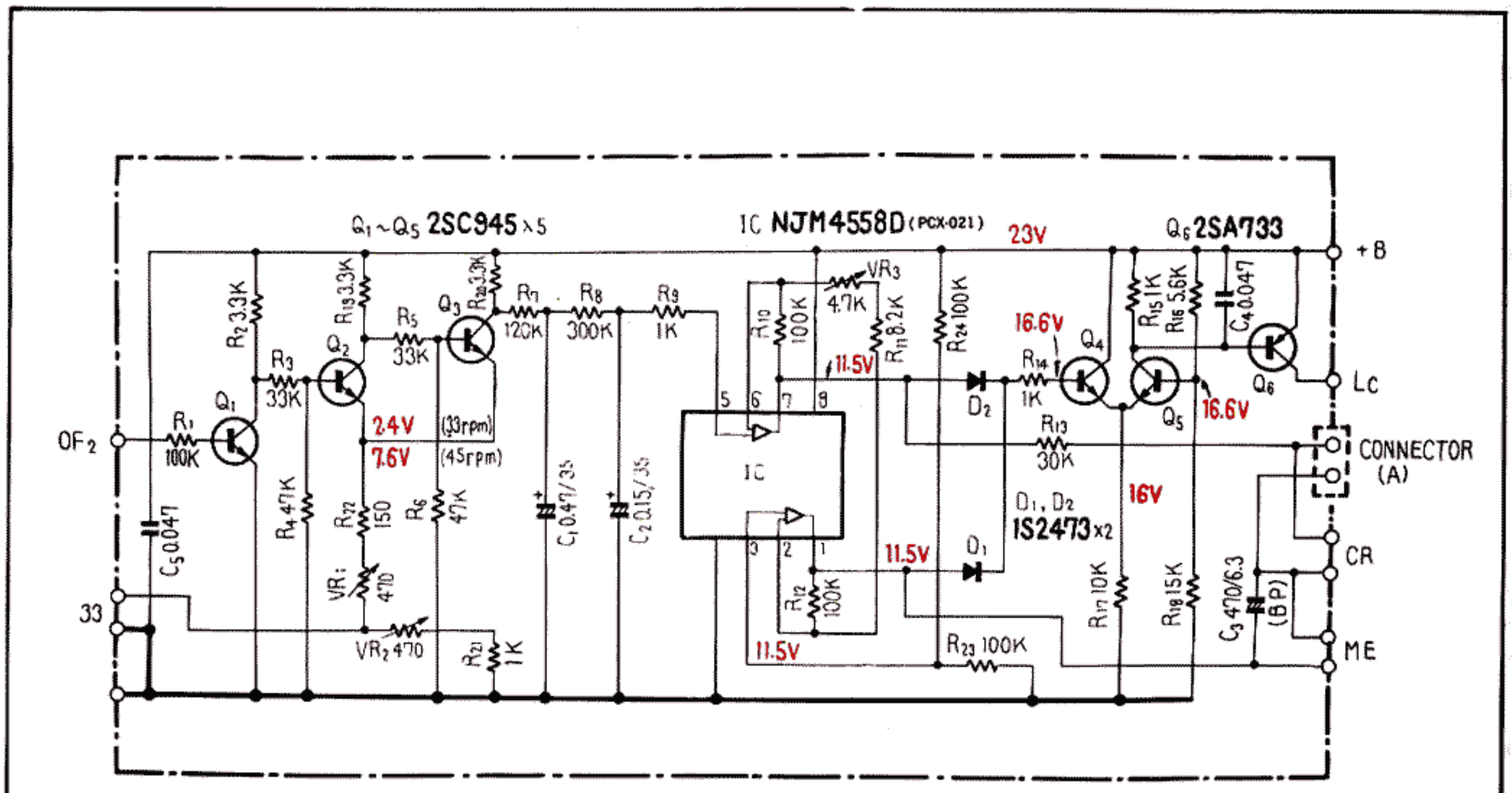
CAPACITORS

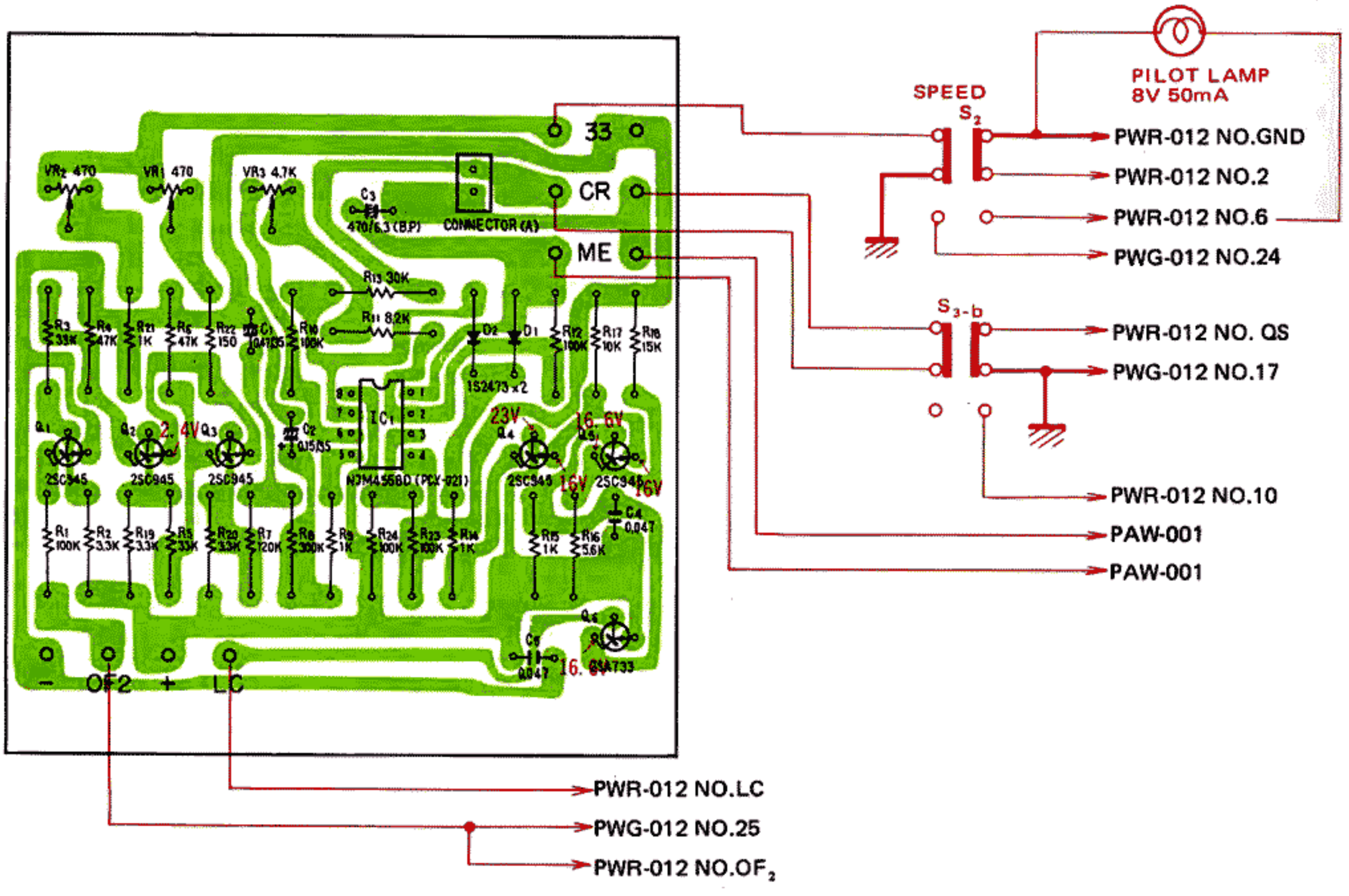
Symbol	Description			Part No.
C1	Electrolytic	2.2	25V	CSZA 2R2K 25
C5	Electrolytic	100	25V	CEA 101P 25
C6	Ceramic	0.01	50V	CKDYF 103Z 50
C7	Ceramic	0.01	50V	CKDYF 103Z 50
C8	Ceramic	0.047	50V	CKDYF 473Z 50
C9	Electrolytic	1000	50V	CEA 102P 50
C10	Electrolytic	10	25V	CEA 100P 25
C11	Electrolytic	2.2	25V	CSZA 2R2K 25
C12	Electrolytic	1000	16V	CEA 102P 16
C13	Ceramic	0.1		KCE-004-A

OTHERS

Symbol	Description	Part No.
	Heat sink	PNS-001
	Heat sink	PNB-241
	Fuse crip	K91-006
	Fuse (1.2A)	PEK-011
	Fuse (400mA)	PEK-012

7.3 METER DRIVE CIRCUIT ASSEMBLY (PWX-010)





Part List of Meter Drive Circuit Assembly (PWX-010)

SEMICONDUCTORS

Symbol	Description	Part No.
Q1	Transistor	2SC945-P or Q (2SC372-Y)
Q2	Transistor	2SC945-P or Q (2SC372-Y)
Q3	Transistor	2SC945-P or Q (2SC372-Y)
Q4	Transistor	2SC945-P or Q (2SC372-Y)
Q5	Transistor	2SC945-P or Q (2SC372-Y)
Q6	Transistor	2SA733-P or Q (2SA495-Y)
D1	Diode	1S2473
D2	Diode	1S2473
IC	NJM4558D	PCX-021

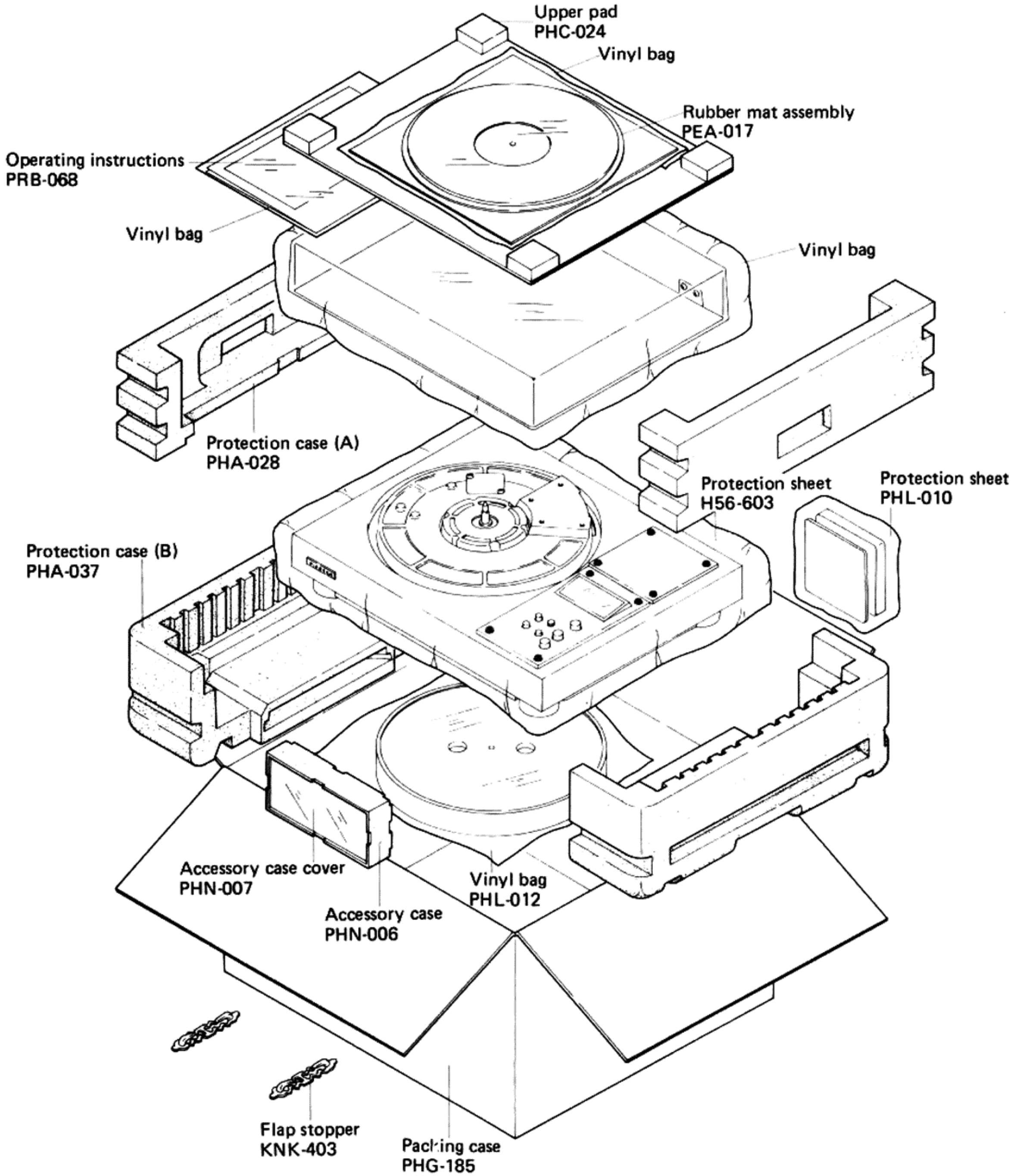
CAPACITORS

Symbol	Description			Part No.
C1	Electrolytic	0.47	25V	CSZA R47K 25
C2	Electrolytic	0.15	25V	CSZA R15K 25
C3	Electrolytic	470	6.3V	CEA 471M 6.3NP
C4	Myler	0.047	50V	CQMA 473K 50
C5	Ceramic	0.047	50V	CKDYF 473Z 50

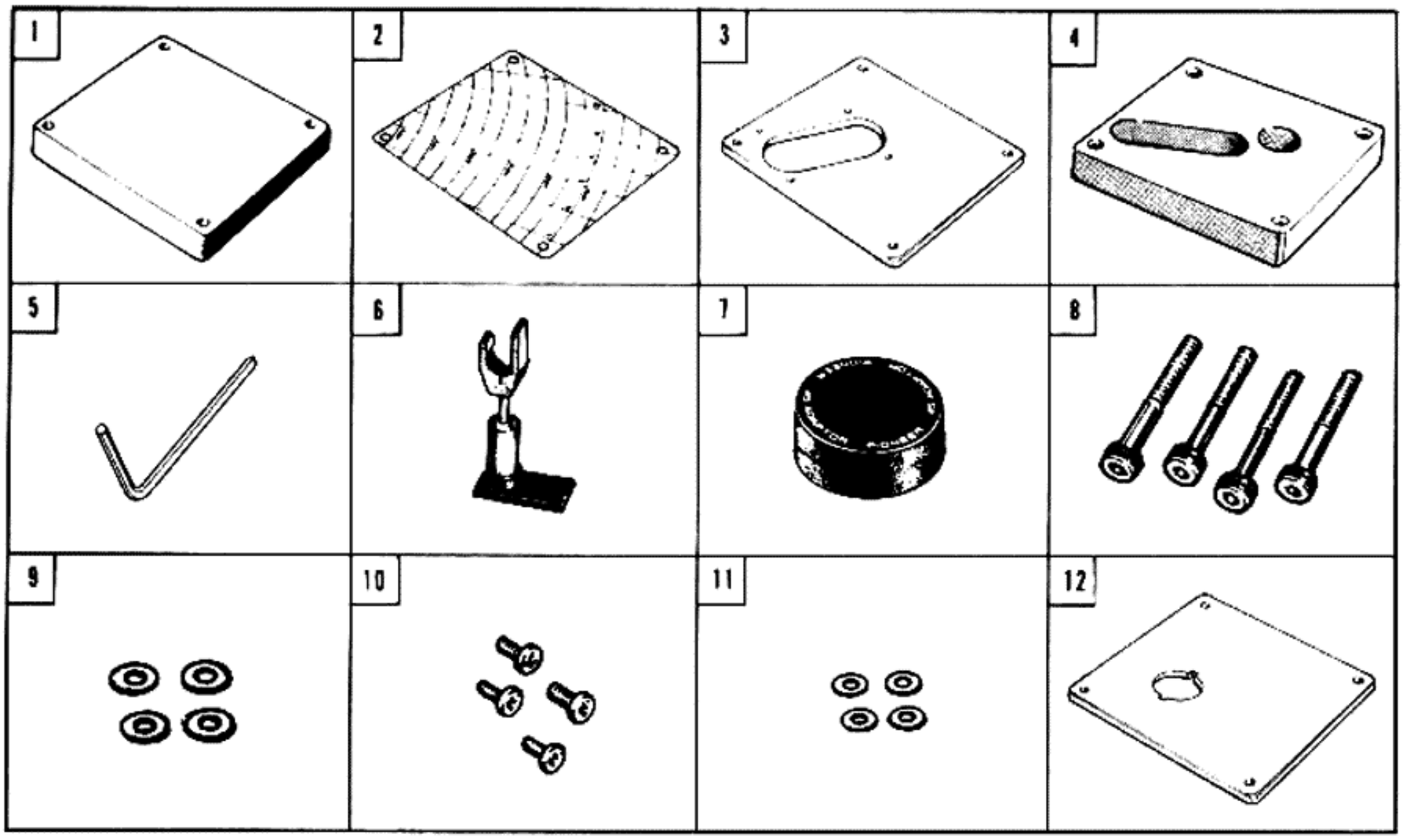
RESISTORS

Symbol	Description		Part No.
VR1	Semi-fixed		PCP-010-0
VR2	Semi-fixed		PCP-010-0
VR3	Semi-fixed		PCP-011-0
R1	Carbon film	100k	RD¼PS 104J
R2	Carbon film	3.3k	RD¼PS 332J
R3	Carbon film	33k	RD¼PS 333J
R4	Carbon film	47k	RD¼PS 473J
R5	Carbon film	33k	RD¼PS 333J
R6	Carbon film	47k	RD¼PS 473J
R7	Carbon film	120k	RD¼PS 124J
R8	Carbon film	300k	RD¼PS 304J
R9	Carbon film	1k	RD¼PS 102J
R10	Carbon film	100k	RD¼PS 104J
R11	Carbon film	8.2k	RD¼PS 822J
R12	Carbon film	100k	RD¼PS 104J
R13	Carbon film	30k	RD¼PS 303J
R14	Carbon film	1k	RD¼PS 102J
R15	Carbon film	1k	RD¼PS 102J
R16	Carbon film	5.6k	RD¼PS 562J
R17	Carbon film	10k	RD¼PS 103J
R18	Carbon film	15k	RD¼PS 153J
R19	Metal film	3.3k	RN¼PR 3301G
R20	Metal film	3.3k	RN¼PR 3301G
R21	Metal film	1k	RN¼PR 1001G
R22	Metal film	0.15k	RN¼PR 1500G
R23	Metal film	100k	RN¼PR 1003G
R24	Metal film	100k	RN¼PR 1003G

8. PACKING


Upper pad
PHC-024
Vinyl bag
Rubber mat assembly
PEA-017
Operating instructions
PRB-068
Vinyl bag
Vinyl bag
Protection case (A)
PHA-028
Protection sheet
H56-603
Protection sheet
PHL-010
Protection case (B)
PHA-037
Accessory case cover
PHN-007
Accessory case
PHN-006
Vinyl bag
PHL-012
Flap stopper
KNK-403
Packing case
PHG-185

Accessory Parts



Symbol	Description	Part No.
1	Tone arm mounting board (A)	PMW-007
2	Tone arm mounting paper	PRF-009
3	SME-3009/I I alumi-panel	PAT-032
4	Tone arm mounting board (D)	PMW-009
5	Hexagonal wrench	PEF-003
6	Arm rest assembly	PXA-286
7	45 rpm adaptor	KNK-055
8	Screw	PBA-052
9	Nylon washer	PBF-002
10	PM 2.6x8	
11	FW 2.6	
12	Tone arm mounting board	PAT-024

PIONEER ELECTRONIC CORPORATION
4-1, Meguro 1-Chome, Meguro-ku, Tokyo 153, Japan
U.S. PIONEER ELECTRONICS CORPORATION
85 Oxford Drive, Moonachie, New Jersey 07074, U.S.A.
PIONEER ELECTRONIC (EUROPE) N.V.
Luithagen-Haven9, 2030 Antwerp, Belgium
PIONEER ELECTRONICS AUSTRALIA PTY. LTD.
178-184 Boundary Road, Braeside, Victoria 3195, Australia

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<ART-223-0>
<77F01Y1K01>

D.D. MOTOR

PXM-051

Additional

Service Manual

PIONEER®

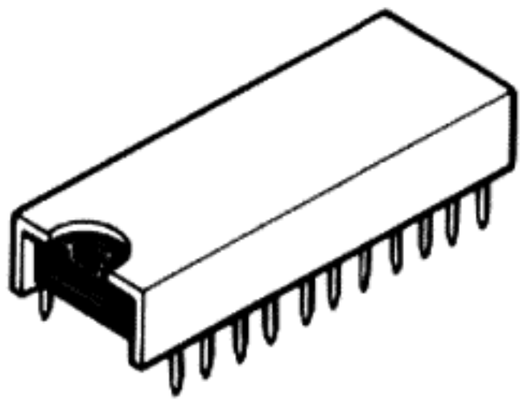
CONTENTS

CAUTION

When Handling IC PD1001A, Please Observe:

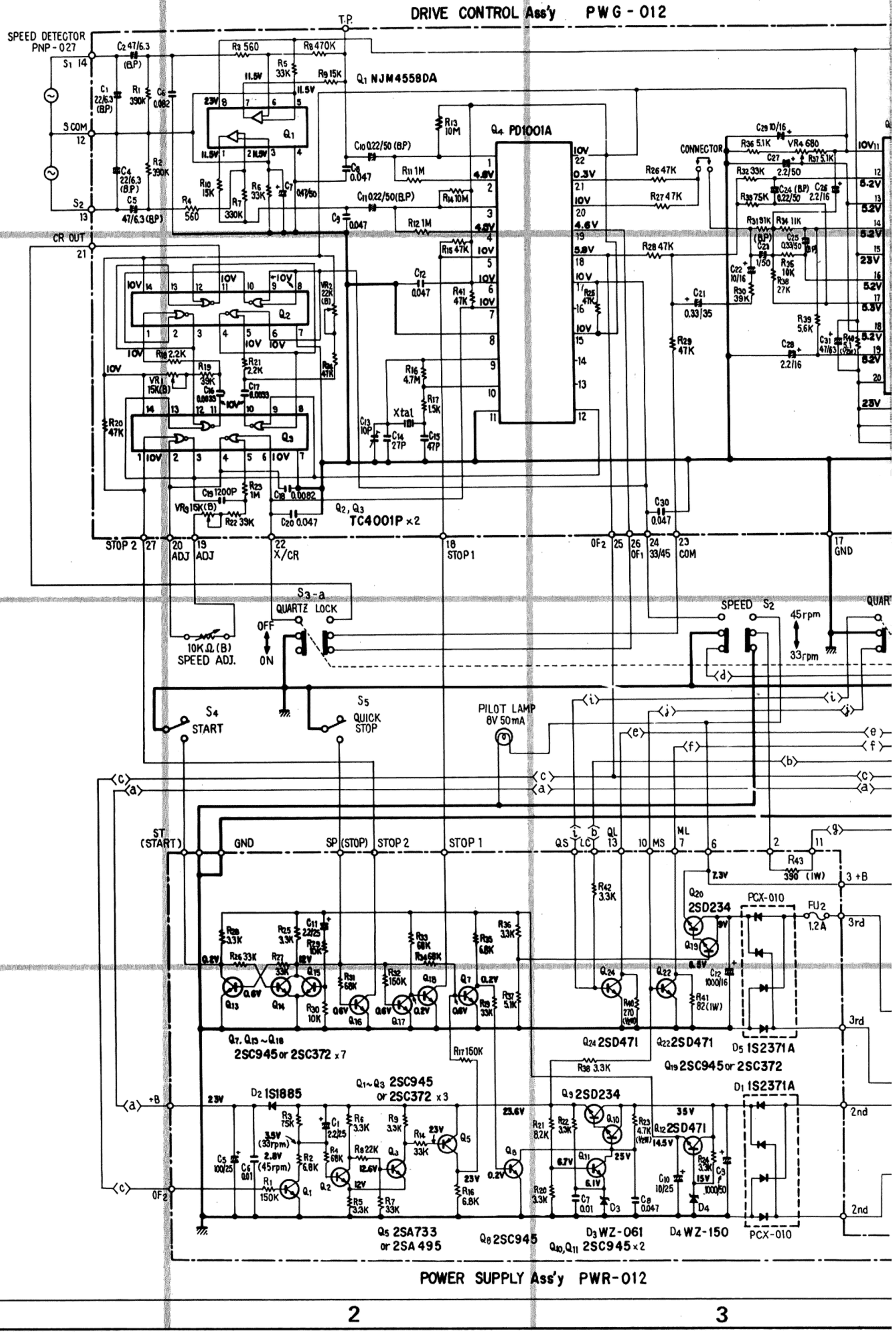
IC PD1001A and TC4001P (in the Drive Control Ass'y PWG-012) is a C-MOS IC of extremely low power consumption and very high input impedance. Unless handled with special care, it could be damaged by static electricity induction. This IC is supplied with a shorting cap (of aluminum foil) attached. When soldering or performing other repair work, always attach this cap as shown below. Remove the cap after the repair has been completed.

Also, this type of IC must not be inserted in a polystyrene package for storage.

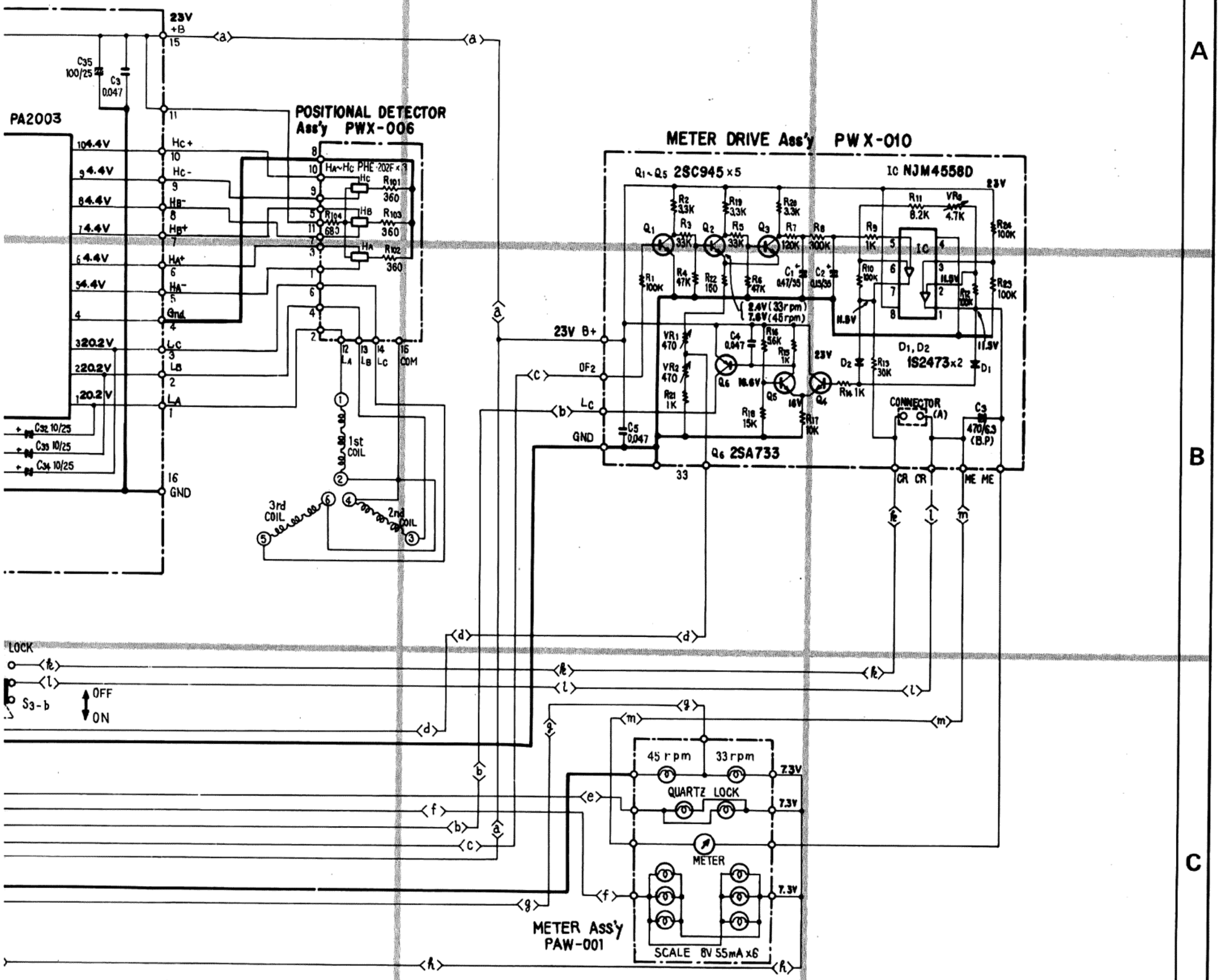


9. SCHEMATIC DIAGRAMS, P.C. BOARD PATTERNS AI

9.1 SCHEMATIC DIAGRAM



ND PARTS LIST



SWITCHES:

S_1 : POWER
OFF — ON

S_2 : SPEED SELECTOR
33 rpm — 45 rpm

S_3 : QUARTZ LOCK
OFF — ON

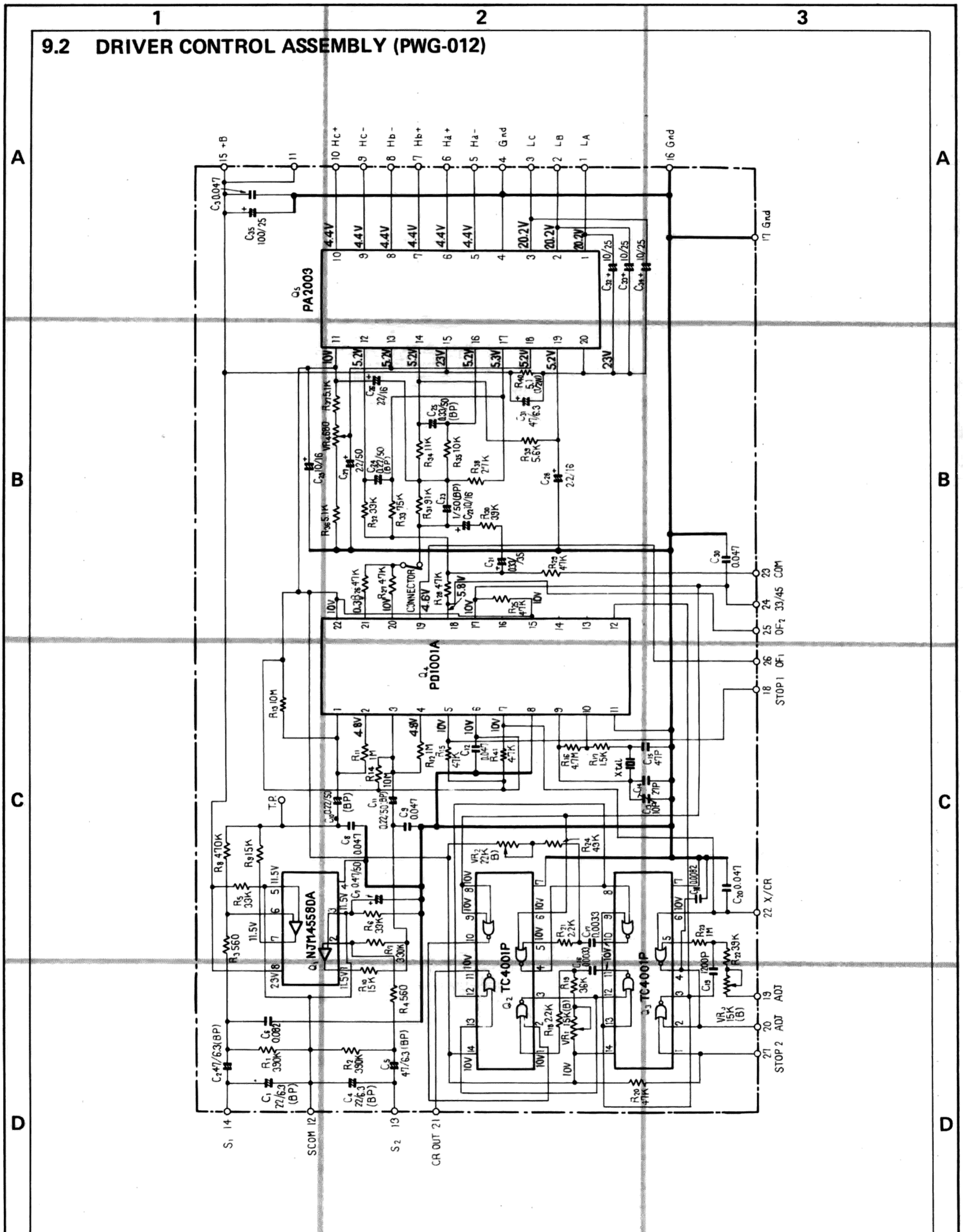
S_4 : START
OFF — ON

S_5 : QUICK STOP
OFF — ON

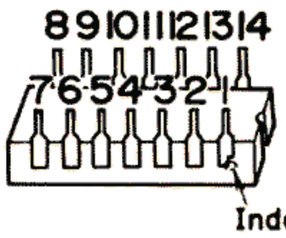
RESISTORS :
IN OHM, 1/4W, ±5% TOLERANCE UNLESS OTHERWISE NOTED. K : kΩ M : MΩ

CAPACITORS :
IN μF UNLESS OTHERWISE NOTED P : pF

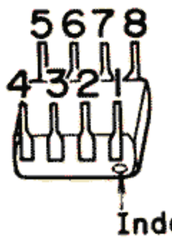
9.2 DRIVER CONTROL ASSEMBLY (PWG-012)



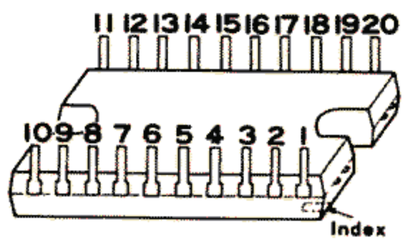
TC4001P



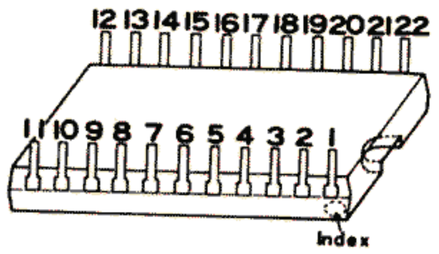
NJM4558DA

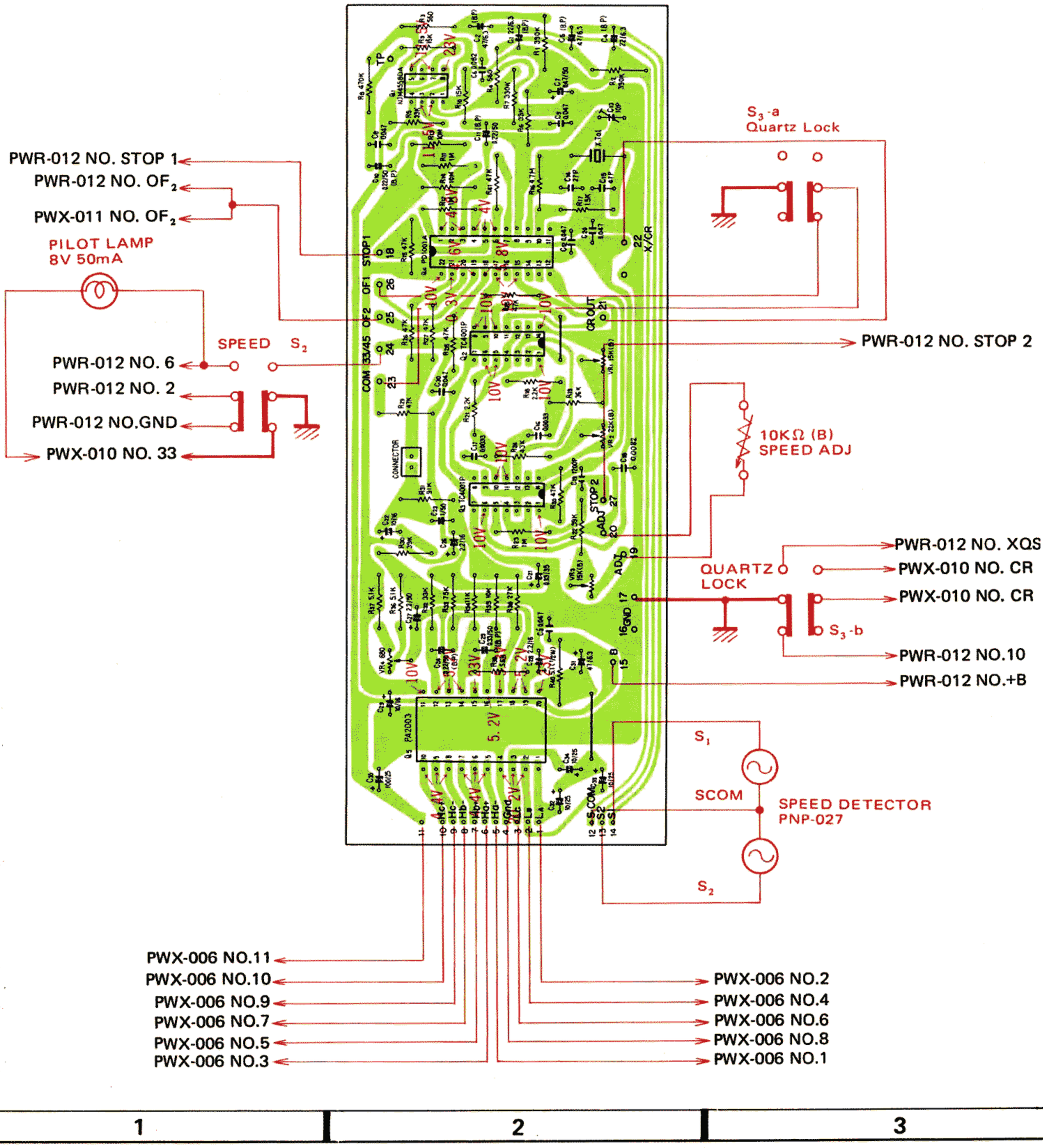


PA2003



PD1001A





Parts List of Drive Control Assembly (PWG-012)

SEMICONDUCTORS

Symbol	Description		Part No.
Q1	IC	NJM-4558DA	PCX-021
Q2	IC	TC4001P	PCX-022
Q3	IC	TC4001P	PCX-022
Q4	IC	PD1001A	PCX-008
Q5	IC	PA2003	PCX-029

RESISTORS

Symbol	Description		Part No.
VR1	Semi-fixed	15k-B	PCP-014
VR2	Semi-fixed	22k-B	PCP-013
VR3	Semi-fixed	15k-B	PCP-006
VR4	Semi-fixed	680-B	PCP-007
R1	Carbon film	390k	RD¼PS 394J
R2	Carbon film	390k	RD¼PS 394J
R3	Carbon film	560	RD¼PS 561J
R4	Carbon film	560	RD¼PS 561J
R5	Carbon film	33k	RD¼PS 333J
R6	Carbon film	33k	RD¼PS 333J
R7	Carbon film	330k	RD¼PS 334J
R8	Carbon film	470k	RD¼PS 474J
R9	Carbon film	15k	RD¼PS 153J
R10	Carbon film	15k	RD¼PS 153J
R11	Carbon film	1M	RD¼PS 105J
R12	Carbon film	1M	RD¼PS 105J
R13	Carbon solid	10M	RC¼P 106M
R14	Carbon solid	10M	RC¼P 106M
R15	Carbon film	47k	RD¼PS 473J
R16	Carbon film	4.7M	RD¼PS 475J
R17	Carbon film	1.5k	RD¼PS 152J
R18	Carbon film	2.2k	RD¼PS 222J
R19	Carbon film	36k	RD¼PS 363J
R20	Carbon film	47k	RD¼PS 473J
R21	Carbon film	2.2k	RD¼PS 222J
R22	Metal film	39k	RN¼PS 393G
R23	Carbon film	1M	RD¼PS 105J
R24	Carbon film	43k	RD¼PS 433J
R25	Carbon film	47k	RD¼PS 473J
R26	Carbon film	47k	RD¼PS 473J
R27	Carbon film	47k	RD¼PS 473J
R28	Carbon film	47k	RD¼PS 473J
R29	Carbon film	47k	RD¼PS 473J
R30	Carbon film	39k	RD¼PS 393J
R31	Carbon film	91k	RD¼PS 913J
R32	Carbon film	33k	RD¼PS 333J
R33	Carbon film	75k	RD¼PS 753J
R34	Carbon film	11k	RD¼PS 113J
R35	Carbon film	10k	RD¼PS 103J
R36	Carbon film	5.1k	RD¼PS 512J
R37	Carbon film	5.1k	RD¼PS 512J
R38	Carbon film	27k	RD¼PS 273J
R39	Carbon film	5.6k	RD¼PS 562J
R40	Carbon film	5.1	RD½PS 5R1J
R41	Carbon film	47k	RD¼PS 473J

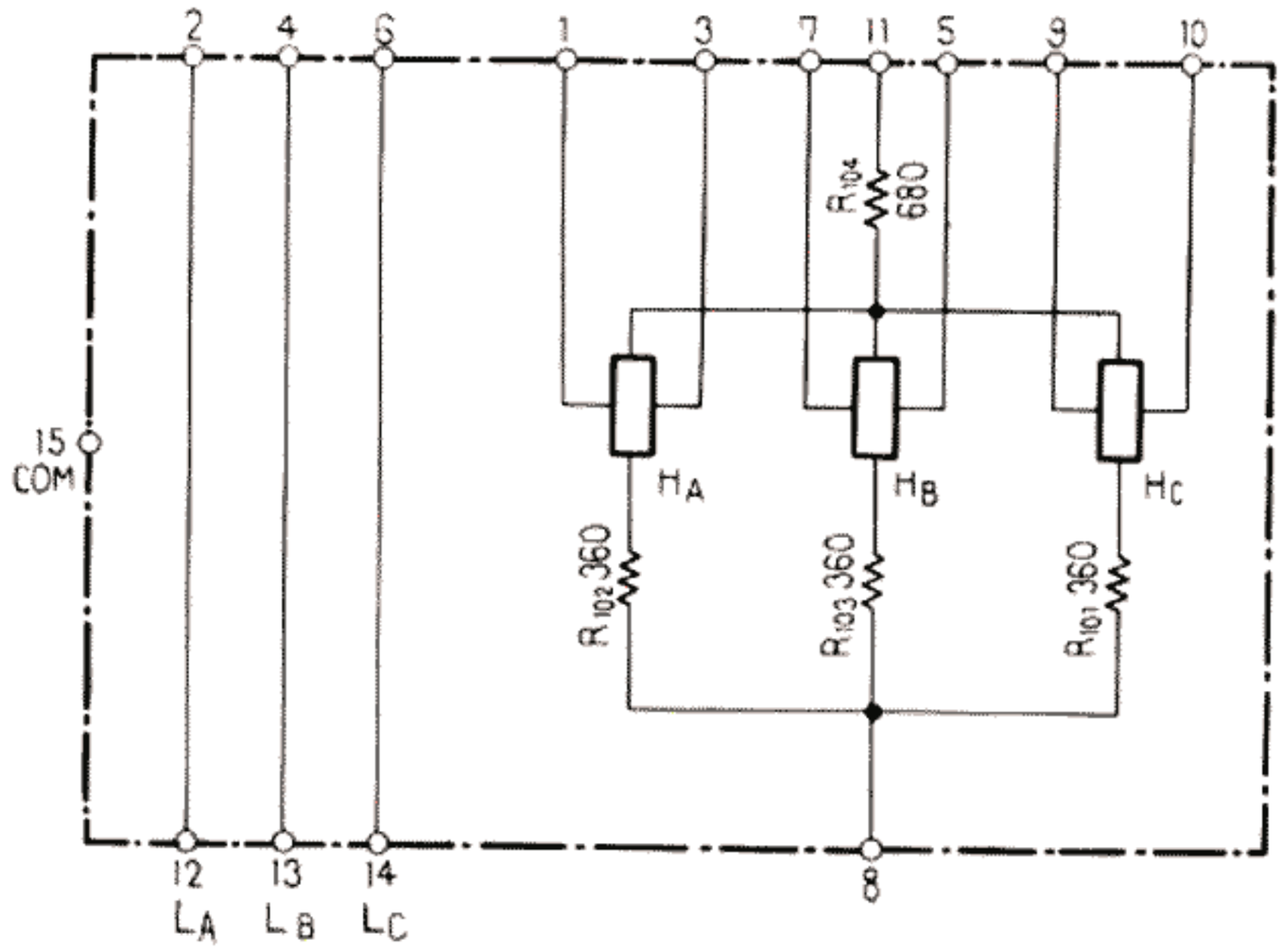
CAPACITORS

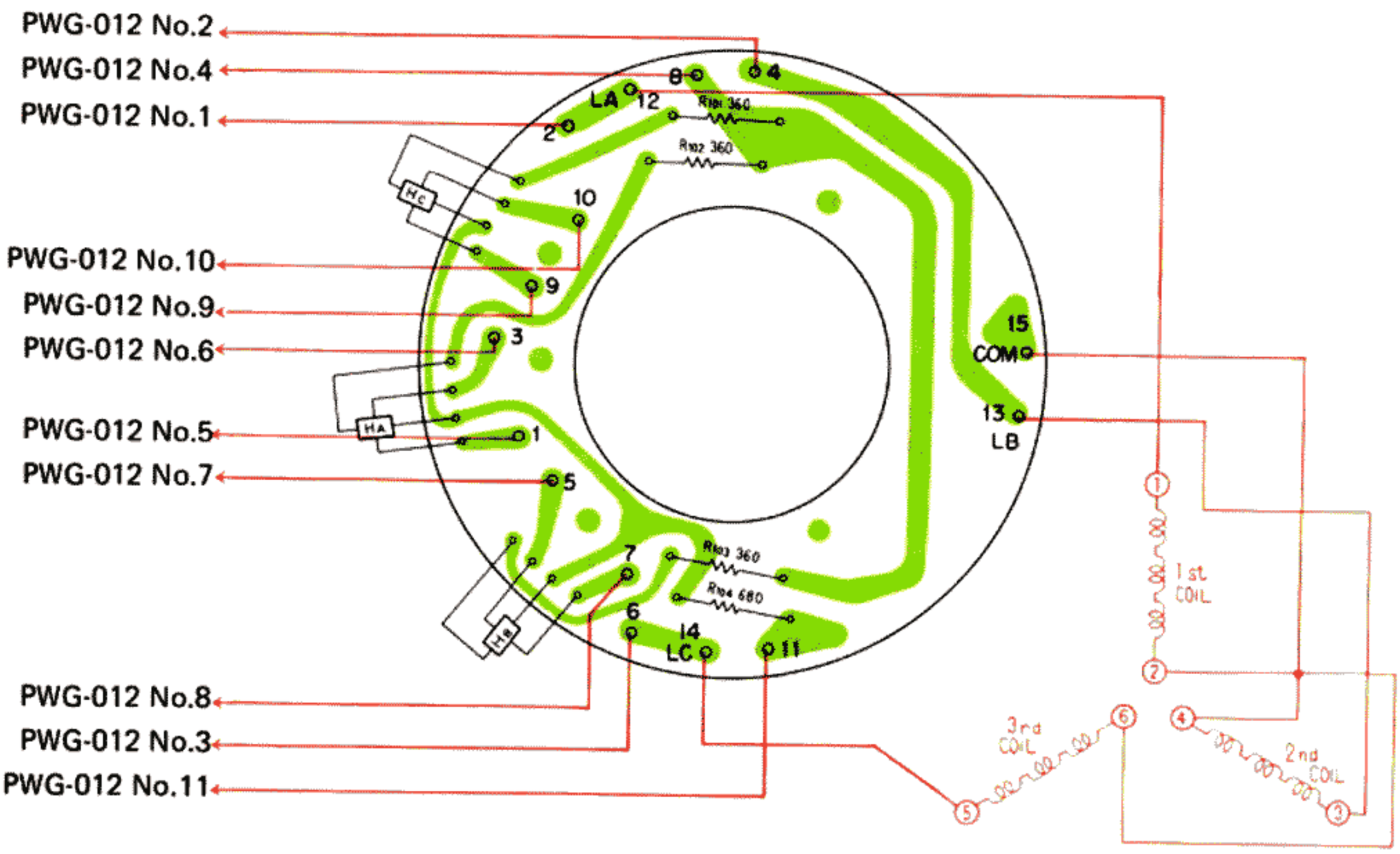
Symbol	Description			Part No.
C1	Electrolytic	22	6.3V	CEA 220M 6.3NP
C2	Electrolytic	47	6.3V	CEA 470M 6.3NP
C3	Ceramic	0.047	50V	CKDYF 473Z 50
C4	Electrolytic	22	6.3V	CEA 220M 6.3NP
C5	Electrolytic	47	6.3V	CEA 470M 6.3NP
C6	Mylar	0.082	50V	CQMA 823K 50
C7	Electrolytic	0.47	50V	CEA R47P 50
C8	Mylar	0.047	50V	CQMA 473K 50
C9	Mylar	0.047	50V	CQMA 473K 50
C10	Electrolytic	0.22	50V	CEA R22M 50NP
C11	Electrolytic	0.22	50V	CEA R22M 50NP
C12	Ceramic	0.047	50V	CKDYF 473Z 50
C13	Ceramic trimmer	10p		PCM-001
C14	Ceramic	27p	50V	CCDCH 270J 50
C15		47p	50V	CCDCH 470J 50
C16	Mylar	0.0033	50V	CQMA 332J 50
C17	Mylar	0.0033	50V	CQMA 332J 50
C18	Mylar	0.0082	50V	CQMA 822K 50
C19	Polystyrene	0.0012	50V	CQSH 122J 50
C20	Ceramic	0.047	50V	CKDYF 473Z 50
C21	Electrolytic	0.33	35V	CSZA R33M 35
C22	Electrolytic	10	16V	CEA 100P 16
C23	Electrolytic	1	50V	CEA 010M 50NP
C24	Electrolytic	0.22	50V	CEA R22M 50NP
C25	Electrolytic	0.33	50V	CEA R33M 50NP
C26	Electrolytic	2.2	16V	CSZA 2R2M 16
C27	Electrolytic	2.2	50V	CEA 2R2P 50
C28	Electrolytic	2.2	16V	CSZA 2R2M 16
C29	Electrolytic	10	16V	CEA 100P 16
C30	Ceramic	0.047	50V	CKDYF 473Z 50
C31	Electrolytic	47	6.3V	CSZA 470M 6.3
C32	Electrolytic	10	25V	CEA 100P 25
C33	Electrolytic	10	25V	CEA 100P 25
C34	Electrolytic	10	25V	CEA 100P 25
C35	Electrolytic	100	25V	CEA 101P 25

OTHERS

Symbol	Description	Part No.
	Heat sink	PNS-002
	Connector assembly (G)	PXA-169
	Connector pin (A)	PKP-008
	Connector pin (E)	PKP-011
	Connector pin (F)	PKP-012

9.3 POSITIONAL DETECTOR ASSEMBLY (PWX-006)





Parts List

RESISTORS

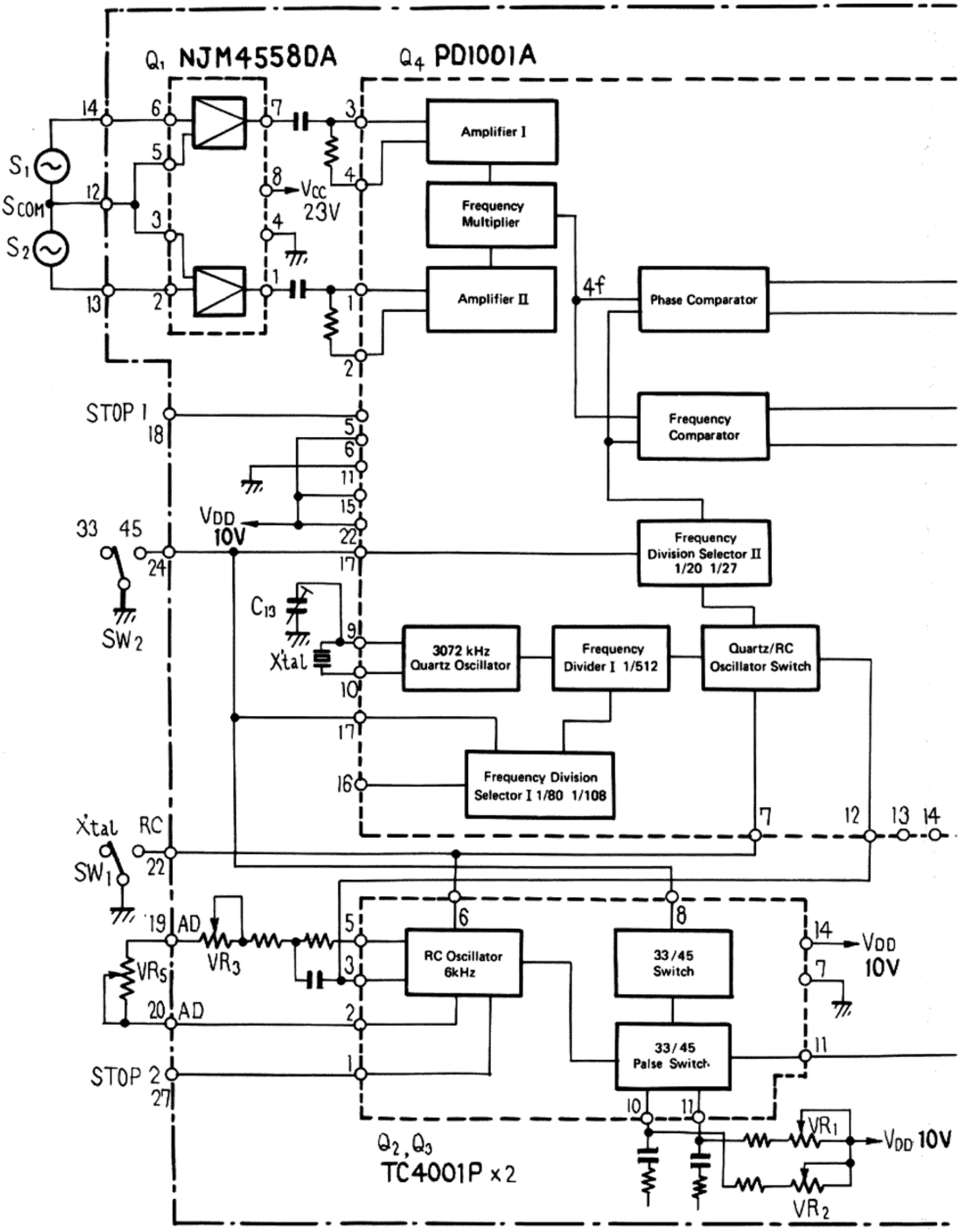
Symbol	Description		Part No.
R101	Carbon film	360	RD¼PS 361J
R102	Carbon film	360	RD¼PS 361J
R103	Carbon film	360	RD¼PS 361J
R104	Carbon film	680	RD¼PS 681J

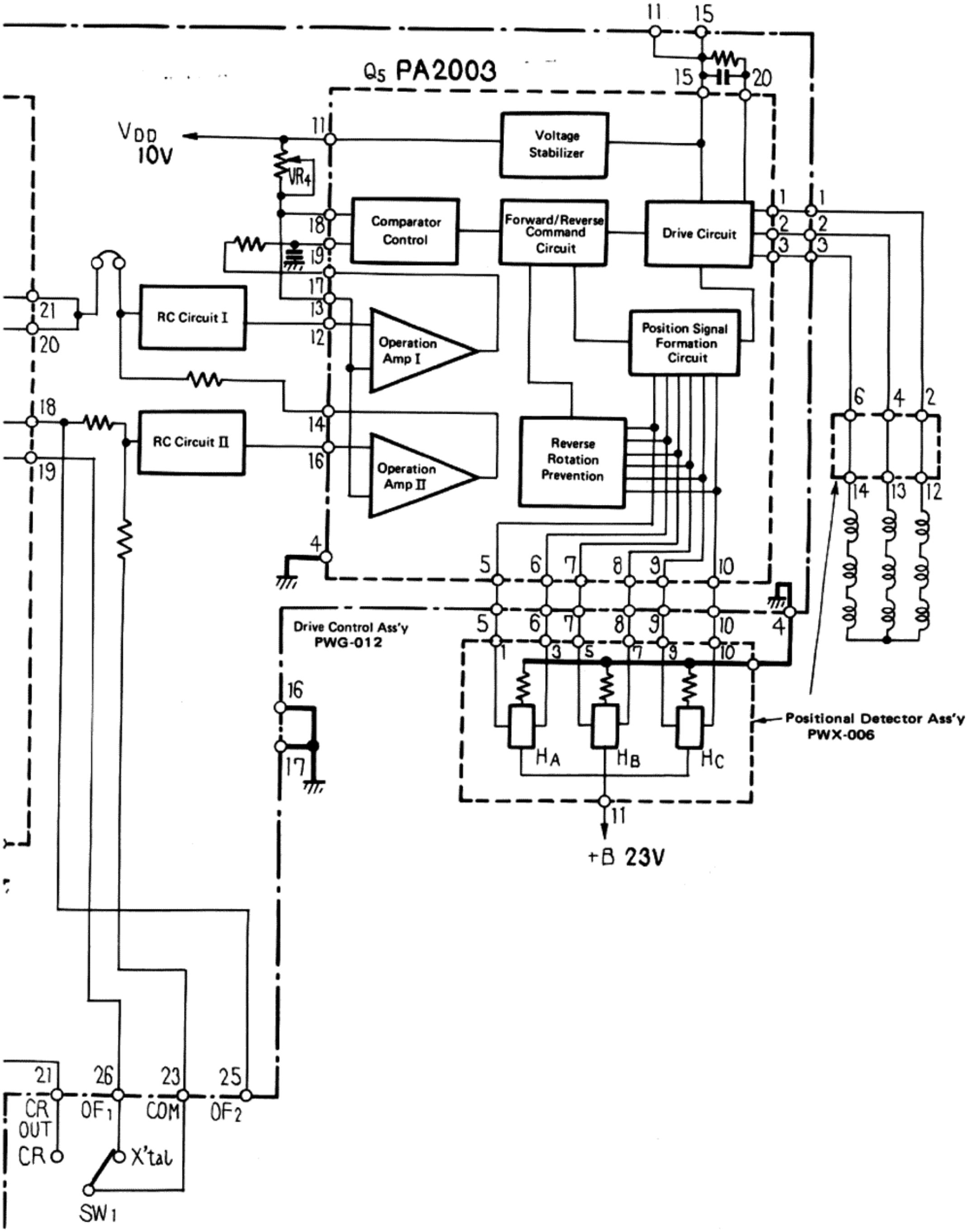
OTHERS

Symbol	Description	Part No.
HA	Hall element	PCX-012
HB	Hall element	PCX-012
HC	Hall element	PCX-012

10. OPERATING PRINCIPLES CIRCUIT DESCRIPTIONS

10.1 BLOCK DIAGRAM




Q5 PA2003
VDD 10V
VR4
Voltage Stabilizer
Comparator Control
Forward/Reverse Command Circuit
Drive Circuit
RC Circuit I
RC Circuit II
Operation Amp I
Operation Amp II
Position Signal Formation Circuit
Reverse Rotation Prevention
Drive Control Ass'y PWG-012
Positional Detector Ass'y PWX-006
HA
HB
HC
+B 23V
CR OUT
CR
OF1
COM
OF2
X'tal
SW1

10.2 MOTOR OPERATION

1 Motor Construction

1. The PXM-051 is an outer-rotor brushless DC motor with 6 poles and 9 slots.
2. Motor windings are arranged in a 3-phase Y configuration. For detection of the platter position, 3 Hall elements are mounted at 40° intervals.
3. As the motor rotates, these Hall elements generate an AC voltage dependent upon the strength and direction of the magnetic flux.
4. The bottom side of the rotor magnet possesses 200 magnetic poles. As these rotate above the speed detection plate, an AC voltage is generated which serves as the speed detection signal.
5. The inner surface of the rotor magnet possesses 6 magnetic poles. As shown in Fig. 2, these are tilted by 23.4° relative to the vertical axis.

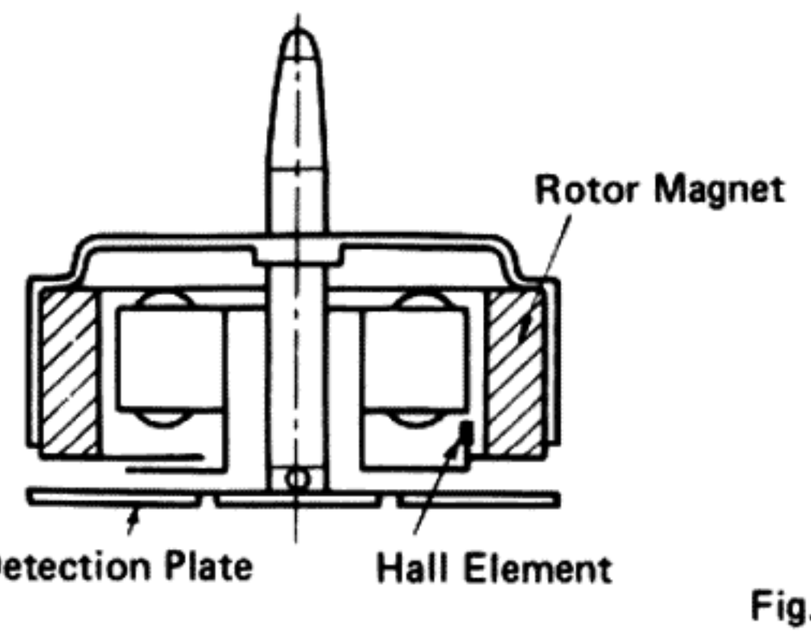


Fig. 1

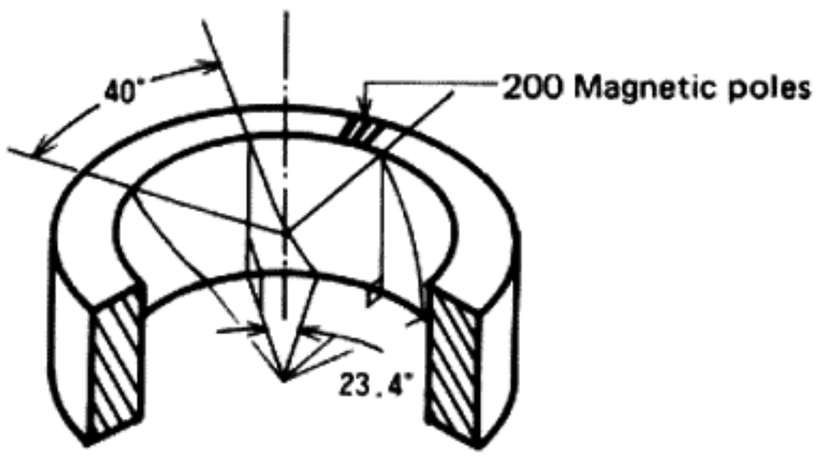


Fig. 2

2. Principle of Motor Rotation

1. Let us assume that the motor is at standstill, in the position shown in Fig. 3.
2. In this position, Hall element H_A is located next to a borderline between south and north poles, H_B next to a south pole, and H_C next to a north pole.
3. When the unit is switched on, the output voltages of the respective Hall elements will be as shown in Fig. 13-a, page 47.
4. The Hall element output is applied to the Position Signal Combination Circuit contained in IC PA2003 and utilized to control the current flowing to the motor drive coils.
   For further details, see paragraph "Drive Circuit." on page 45.
5. The output from the Hall elements undergoes waveform formation in the Position Signal Combination circuit. The resulting waveforms are shown in Fig. 13-b, page 47.
6. These composite signals are used to switch the drive current in such a way that each motor winding receives the proper current to polarize the magnetic poles for north, south, or OFF in the correct sequence.

In actual rotation, this happens as follows.

7. As the pole of coil L_A becomes a south pole, that of L_B becomes north, and L_C, neutral.
8. Repulsion between the S pole at L_A and the rotor S pole, and attraction between the L_B N pole and the rotor S pole exert a propulsive force on the rotor.
9. As the rotor turns through 20° of arc, the output from the Hall elements changes.
10. L_B now enters OFF state, L_C becomes a N pole, and L_A a S pole.
11. The L_C N pole now attracts the rotor S pole, and the L_A S pole attracts the rotor N pole. Rotation continues.
12. Correspondences between rotor positions and coil polarities are shown in Fig. 4, a-f.

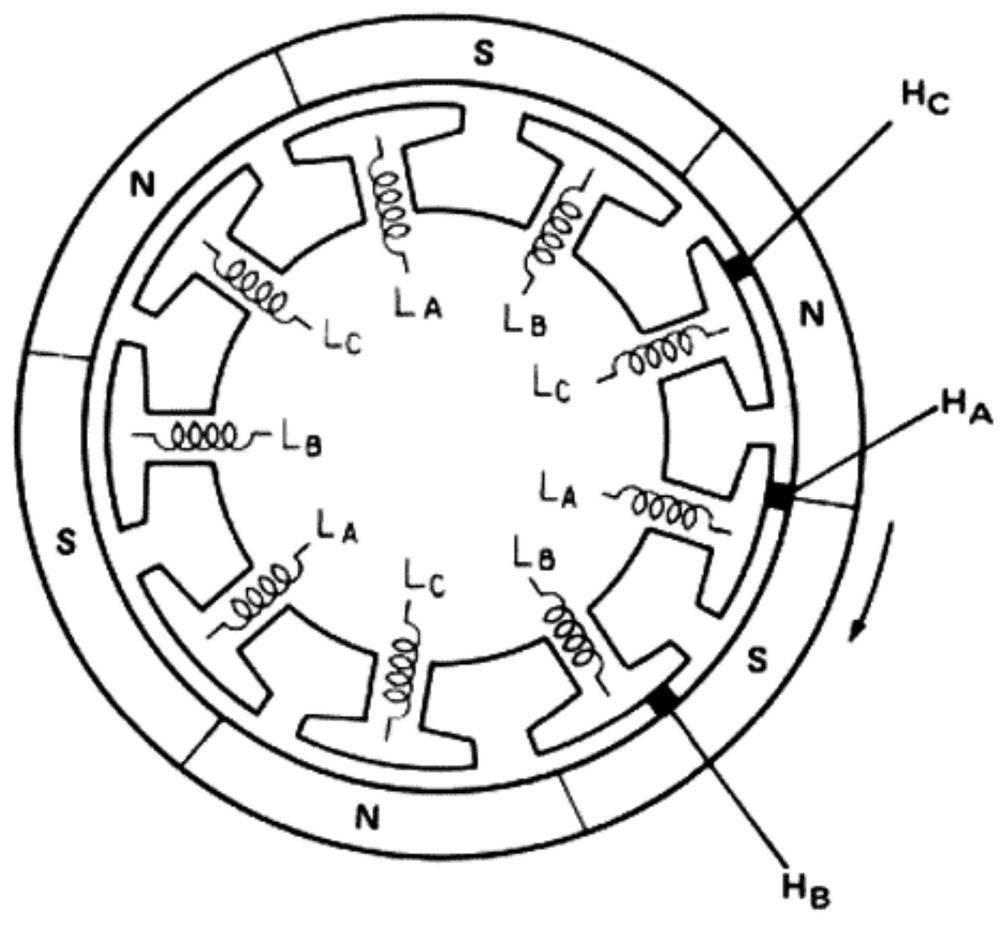


Fig. 3

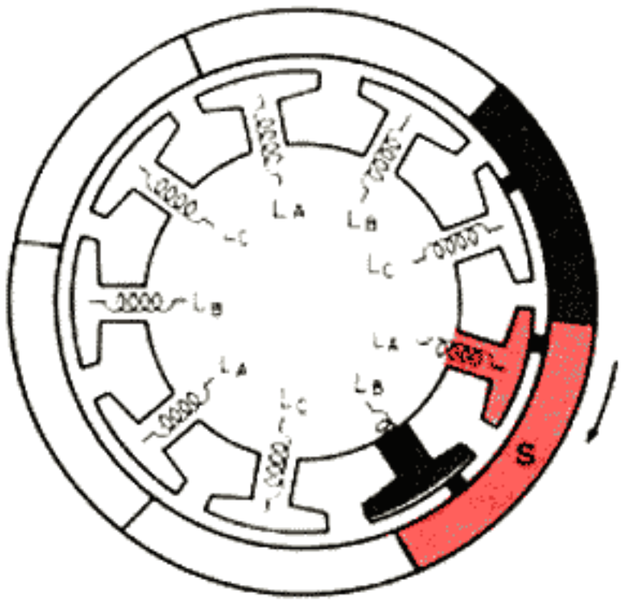


Fig. 4-a

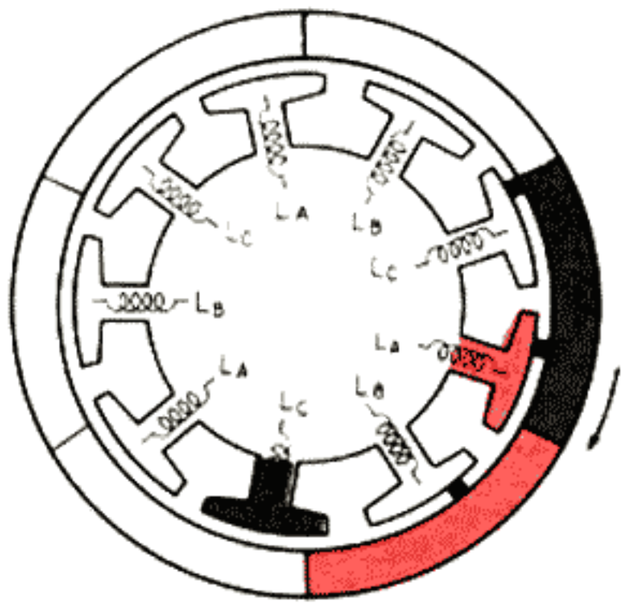


Fig. 4-b

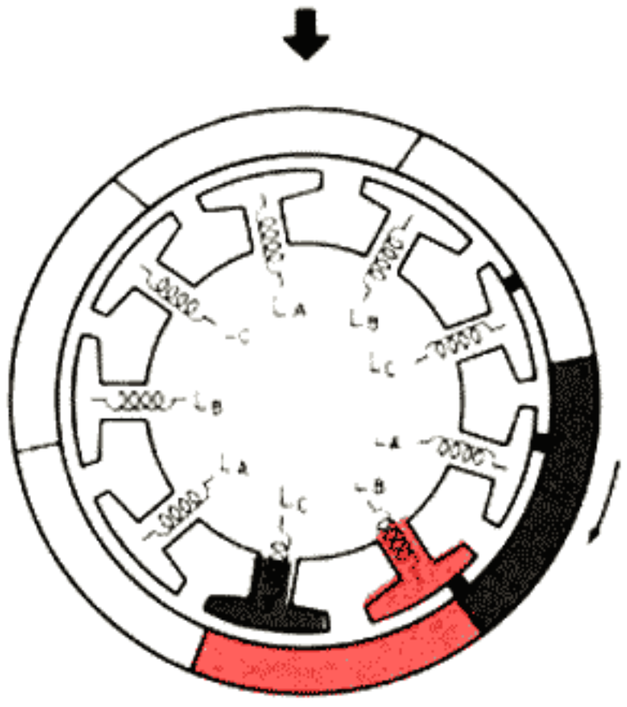


Fig. 4-c

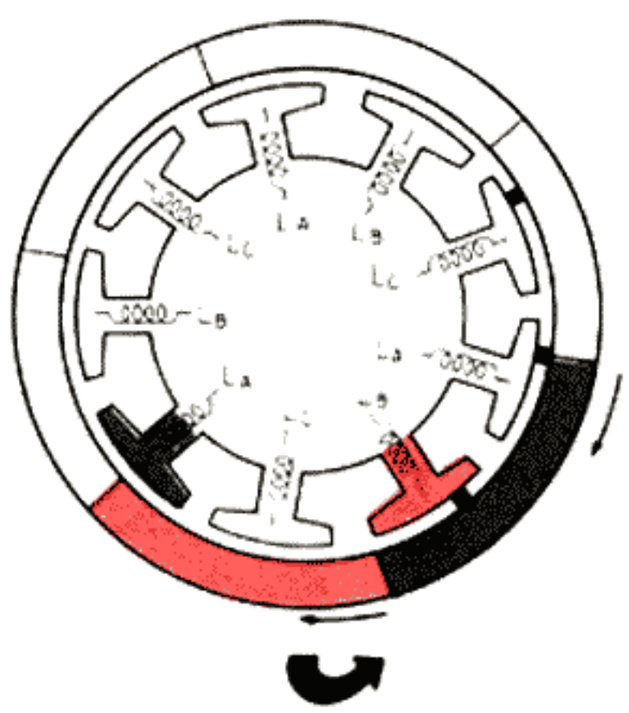


Fig. 4-d

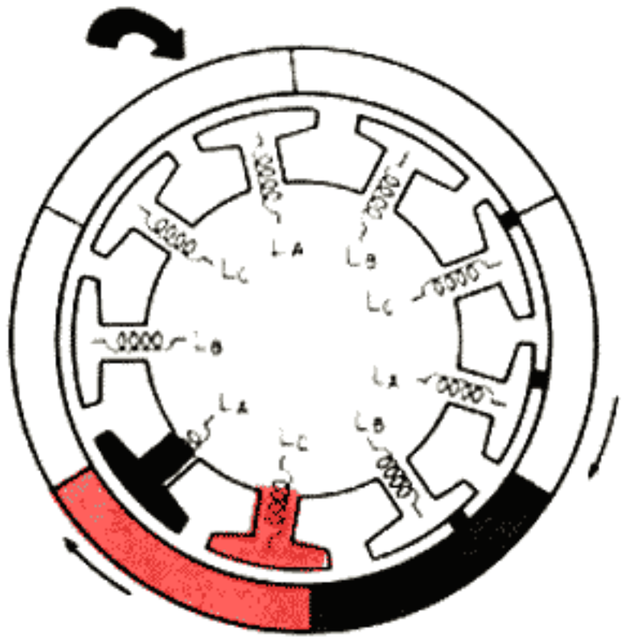


Fig. 4-e

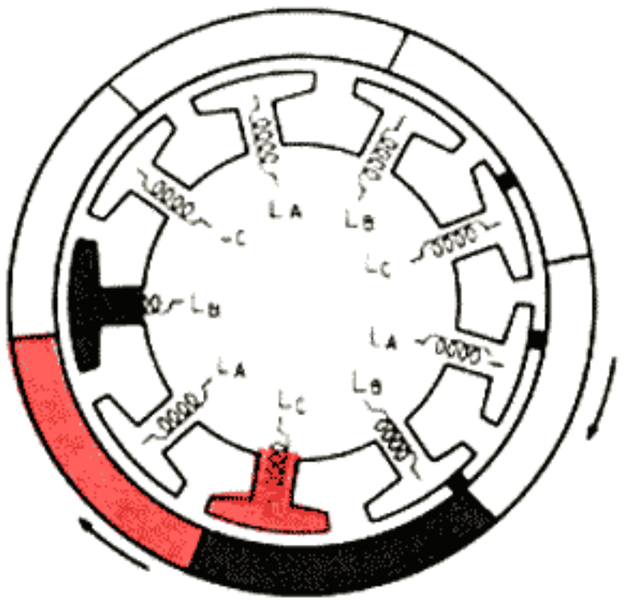


Fig. 4-f

3. Speed Detection Section

1. The speed detection plate has two rows of "detection patterns."
2. The bottom surface of the rotor is magnetized with 200 magnetic poles, and these rotate at a short distance above the speed detection plate.
3. The output voltages obtained from the inner and outer detection patterns differ 90° in phase.
4. The output voltage from the detection patterns has a frequency of 55.5Hz at 33-1/3 rpm, and of 75Hz at 45 rpm.
5. The two signals are amplified by IC = NJM4558DA (Q1). PD1001A, respectively, and then supplied to IC.

4. Functions of IC=PD1001A

1. When the power is turned on, the Quartz Oscillator supplies a quartz-controlled signal of 3072kHz.
2. This frequency is divided by 512 ($512 = 2^9$), becoming 6kHz. This signal then passes through the Quartz/RC Oscillator Switch and on to the Frequency Division Selector II.
3. The Frequency Division Selector I supplies a signal for the stroboscopic lamp. For this purpose, it divides by 80 (giving a signal of

75Hz for 45 rpm) or by 108 (giving a signal of 55.5Hz for 33-1/3 rpm).

NOTE:
Since the PLC-590 is not equipped with a stroboscopic light, this circuit is not used.

4. Division in the Frequency Division Selector II is by 20 (giving 300Hz for 45 rpm) or by 27 (giving 222Hz for 33 rpm). The output signal is then passed on to the Phase Comparator and the Frequency Comparator where it is compared with the speed detection signal.
5. The speed detection signals, after amplification by Q1 and Q2 (waveforms shown in Fig. 5-a) undergo waveform formation in amplifiers AMP I and AMP II. The resultant waveforms are shown in Fig. 5-b. They then enter the Frequency Multiplication Block.

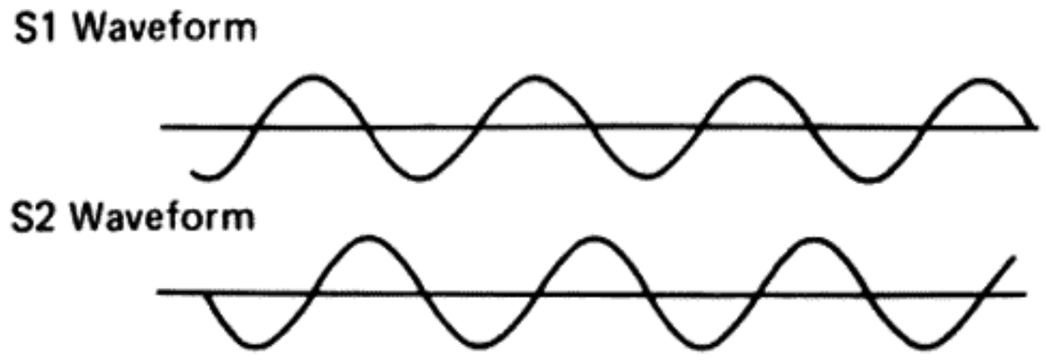


Fig. 5-a

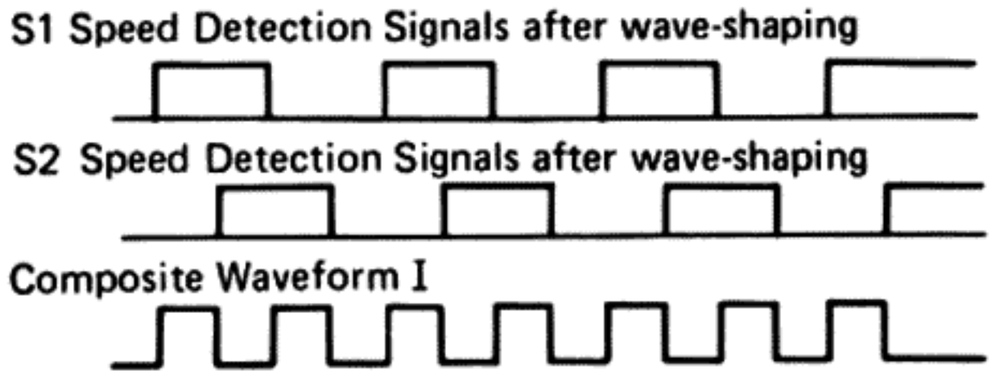


Fig. 5-b

Fig. 5-c

6. In the Frequency Multiplier, the 90° phase difference between the two signals is utilized to produce, in a logic circuit, a composite signal of double frequency; this is then multiplied by 2 once again, resulting in four times the original frequency. See Fig. 5-c.
7. This Speed Detection Signal x 4 is then compared with the quartz-derived reference signal in the Phase and Frequency Comparators.
8. If the phase of the detection signal lags that of the reference signal, the combined PC output voltage (at pins 21 and 22 of PD-1001) will rise; conversely, if the detection signal phase leads that of the reference signal, PC output will drop. See Fig. 6-a. The former case indicates that turntable rotation is too slow. The latter case means that the turntable is rotating too fast.
9. Similarly, if the frequency of the detection signal is lower than that of the reference signal, the voltage of the combined FC output signal (pins 18 and 19 of PD1001A) will drop. Conversely, this voltage will rise if the detection signal frequency is higher than the reference signal frequency. See Fig. 6-b. Again, the former case indicates slower than rated turntable rotation, while the latter case means faster than rated rotation.

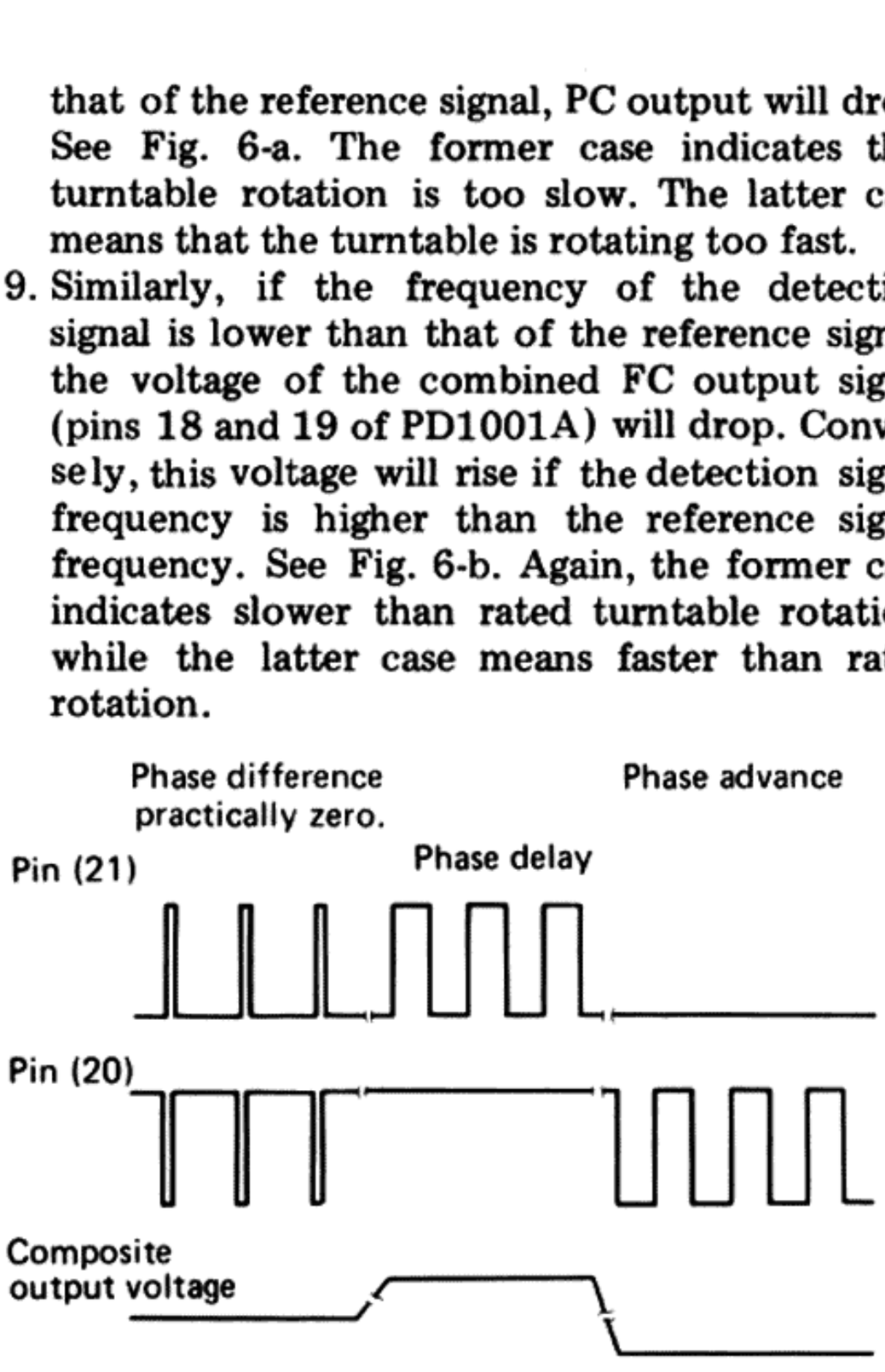


Fig. 6-a

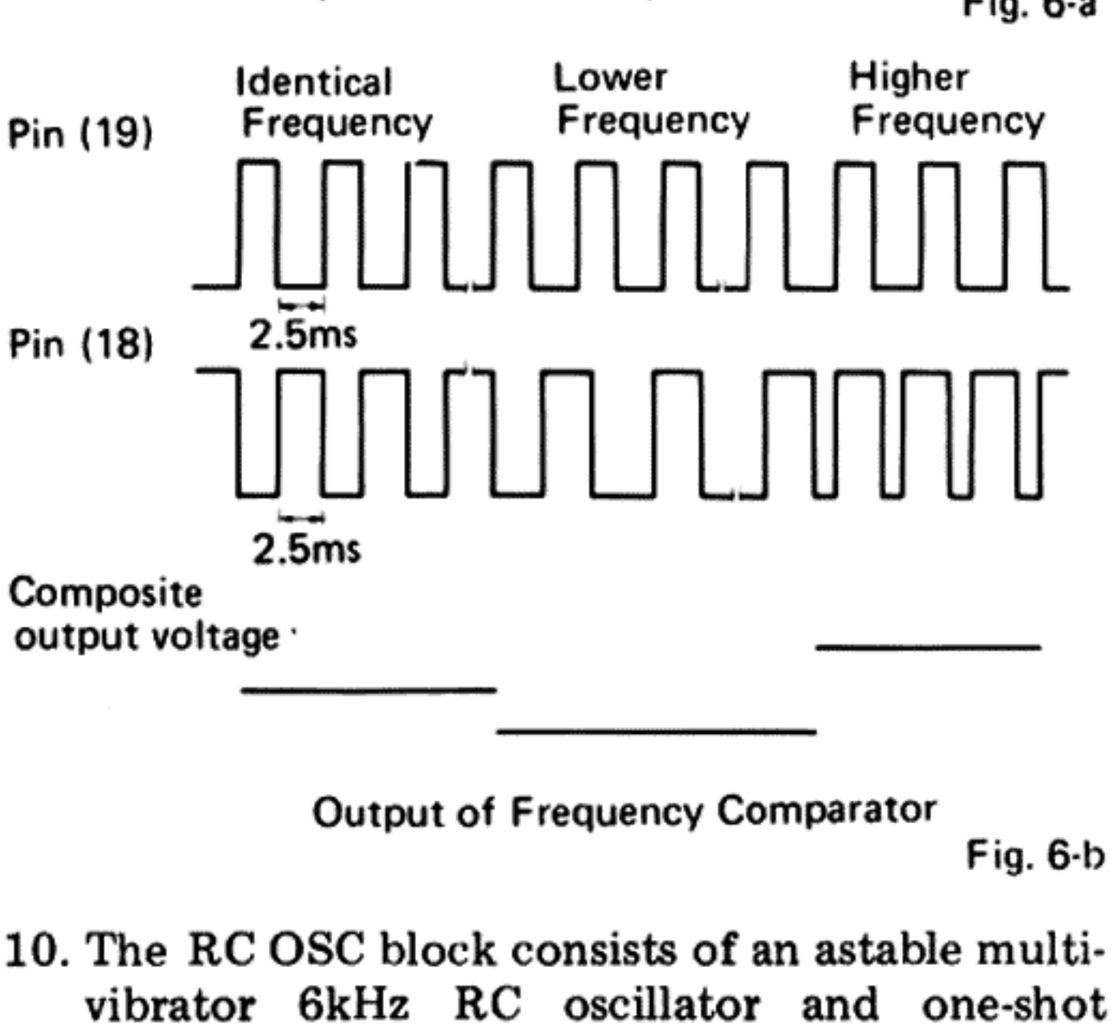


Fig. 6-b

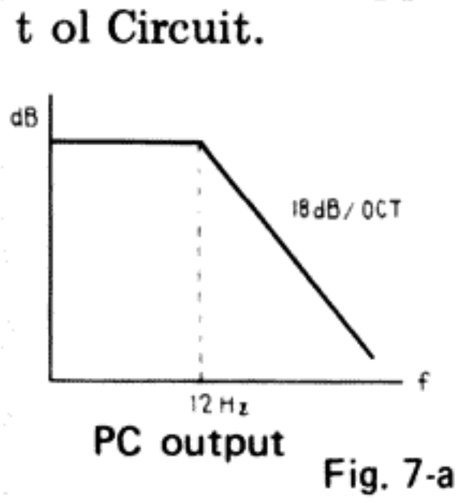
10. The RC OSC block consists of an astable multivibrator 6kHz RC oscillator and one-shot multivibrator pulse width adjustment circuit. Since the Xtal/RC switching block selects the RC oscillator when Quartz Lock is OFF, the oscillator output is sent to division ratio selector II, where it is divided and sent to PD and FD, the same as at Quartz Lock ON. Moreover, the output of the one-shot multi-

vibrator is adjusted to the pulse width required for 33rpm and 45rpm and combined with the FC output (OF 2).

11. The oscillation frequency (6kHz) of the RC OSC block can be varied by ±6% with the SPEED ADJ control.
12. Since the reference signal is varied with the SPEED ADJ at Quartz Lock OFF, the speed of the turntable is also variable ±6%.

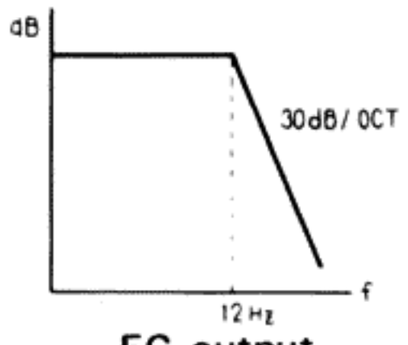
5. The Active Filter

1. The output from the Phase and Frequency Comparators contains unwanted harmonics resulting from the reference frequency and the (multiplied) speed detection signal frequency (222, 300Hz).
2. In order to remove these harmonics, an active filter is provided in the IC PA2003 (as an RC circuit in the Operation Amplifiers I & II).
3. To remove these harmonics with a low pass filter, it is necessary to provide a large amount of attenuation at the higher frequencies without causing major phase changes at the low frequencies.
4. For the output of the Phase Comparator, this attenuation is obtained in two steps: a 12dB/oct. active filter made up of a RC circuit I and Operation Amplifier I; and a passive 6dB/oct. filter consisting of R39 and C28; resulting in an overall attenuation of 18dB/oct. See Fig. 7-a.
5. For the output of the Frequency Comparator, the necessary attenuation of 12dB/oct. is obtained in the active filter formed by RC circuit II and Operation Amplifier II. The signal then passes through R38 and is combined with the Phase Comparator output.
6. Since the Frequency Comparator output passes through two active (and one passive) filters, its total high range attenuation amounts to 30dB/oct. See Fig. 7-b.
7. The cut-off frequency of each filter is set at 12Hz.
8. The active filters also function as inverting amplifiers. Their output phases are inverted relative to the Phase Comparator output. The output is the supplied to the Comparator Control Circuit.



PC output

Fig. 7-a

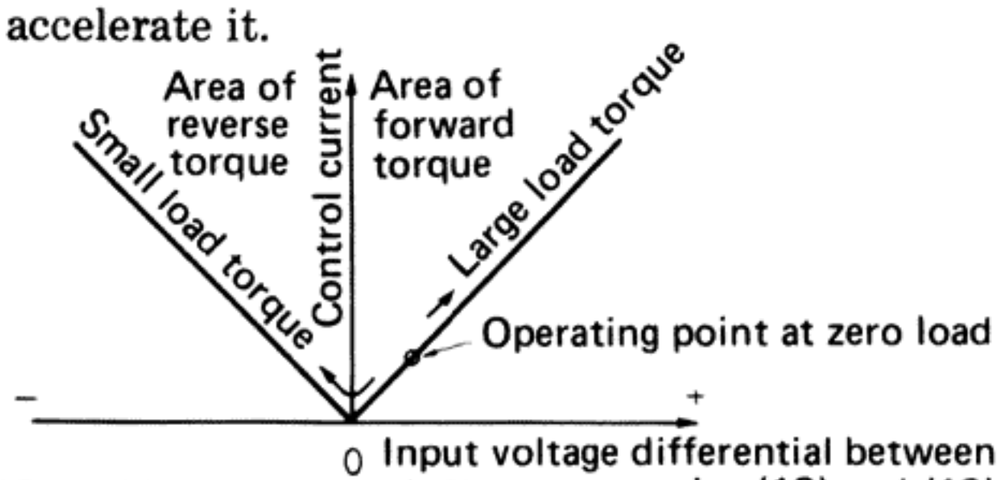


FC output

Fig. 7-b

6. Comparator Control and Forward/Reverse Command Circuit

1. Two inputs are supplied to the Control Comparator: a) a 5V reference voltage from the voltage stabilizer; and b) the output from the active filters, which serves as the detection signal.
2. If the turntable rotates faster than rated speed, the detection signal is higher than the 5V reference.
3. When this happens, the Comparator Control sends a command to the Forward/Reverse Command Circuit, telling it to apply a reverse torque to the motor to slow it down.
4. Conversely, if turntable rotation is below rated speed, the detection signal voltage will be below the 5V reference.
5. In this case, the Comparator Control indicates to the Forward/Reverse Command C rcuit that forward torque must be applied to he motor to accelerate it.



V18. . . Voltage at pin (18)
V19. . . Voltage at pin (19)

Fig. 8

7. Drive Circuit

1. Switching signals obtained from the three Hall elements and having been processed in the Position Detection Signal Formation Circuit, applied to terminals a, b and c in Fig. 9, in order to switch transistors Q2 ~ Q7.
2. These signals are step waves as shown in Fig. 10, with relative phase differences of 120° between them.

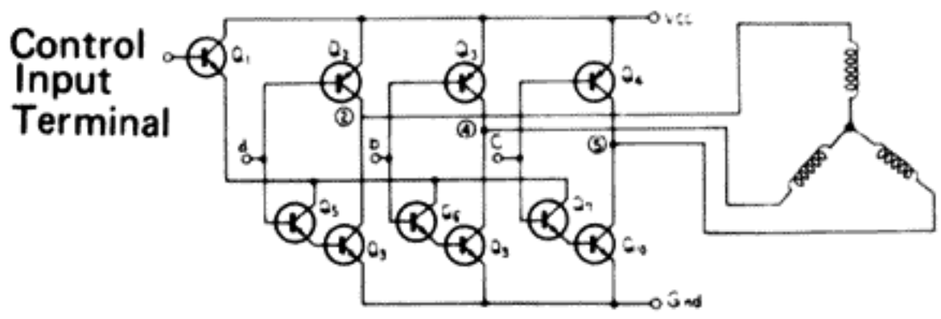


Fig. 9

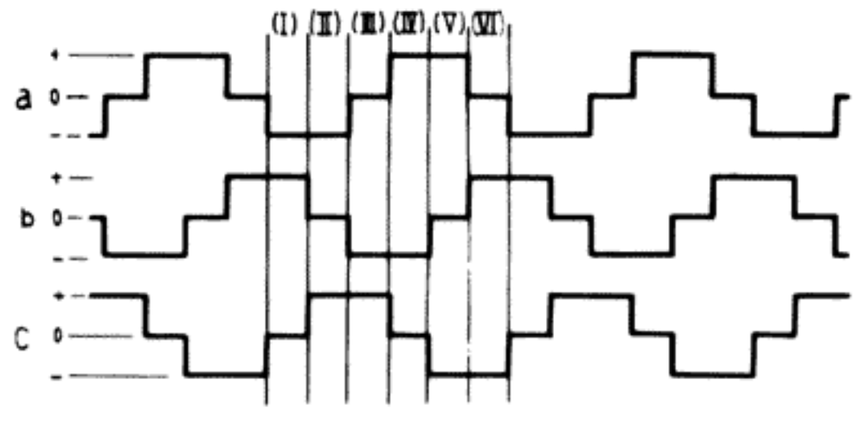


Fig. 10

3. Because of the low potential at pin (a), Q2 is ON. Pin (b) is at high potential, so Q6 and Q9 are ON. Pin (c) is at standard potential — a standard bias is applied which keeps transistors Q4, Q7 and Q10 OFF.
4. A current caused by voltage V_{CC} flows through Q2 — (2) — coil L_A — coil L_B — (4) — Q9, causing a north pole to appear at L_B and a south pole at L_A.
5. This magnetism causes the rotor to start rotating. After 20 degrees of rotation, the signal levels at terminals a, b and c will be come as shown in Fig. 11-b II, and the current path of the drive current is changed. After another 20 degrees of rotation, the signals become as in Fig. 11-c III, and the drive current path is changed again. This process continues, with current path changes every 20 degrees and signal levels as in Figs. 11-d IV, 11-e V, and 11-f VI, whereupon the cycle returns to 11-a and repeats.
6. Also, a control signal from the Forward/Reverse Command Block is applied to the control input terminal, and this controls the current flow through the motor windings.

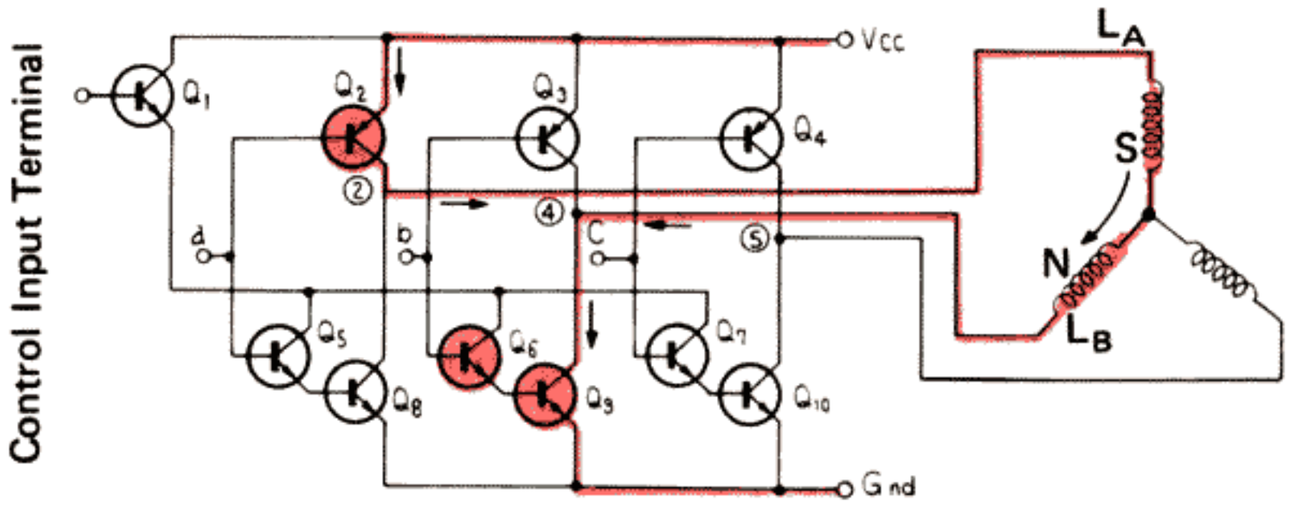


Fig. 11-a

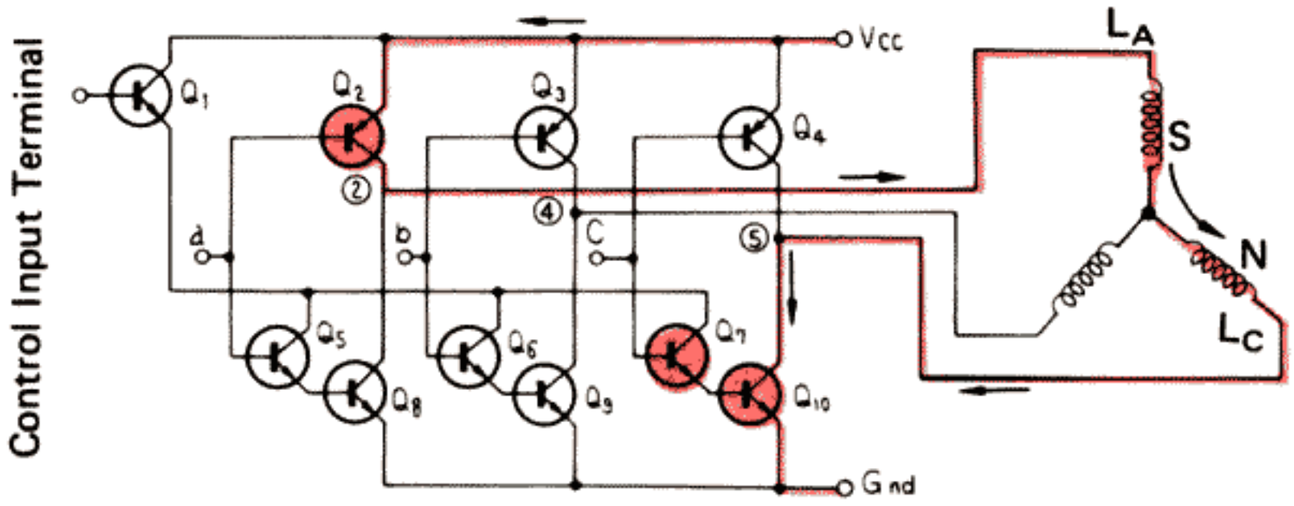


Fig. 11-b

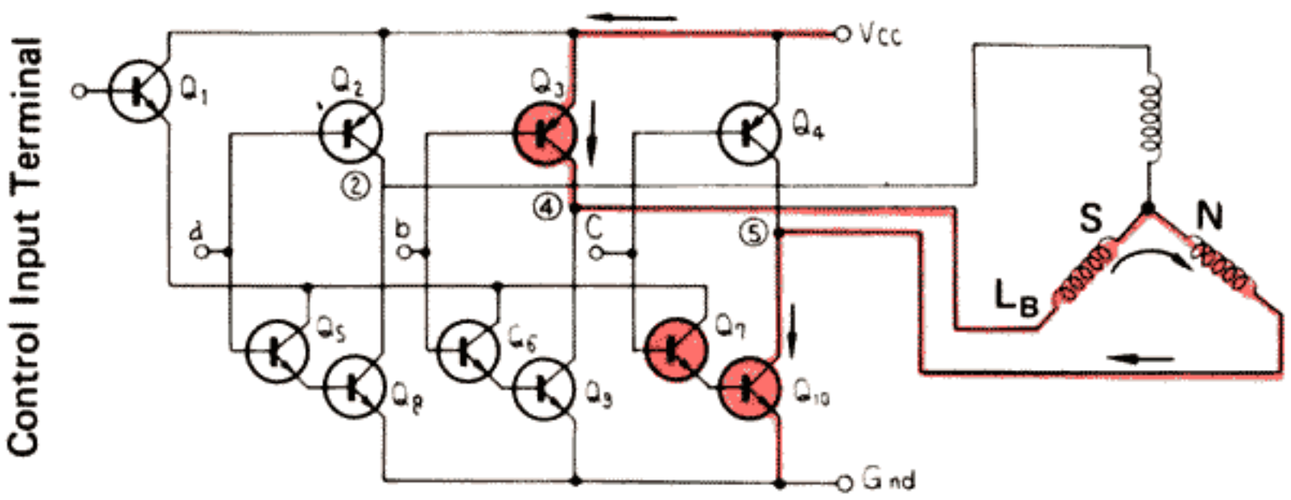
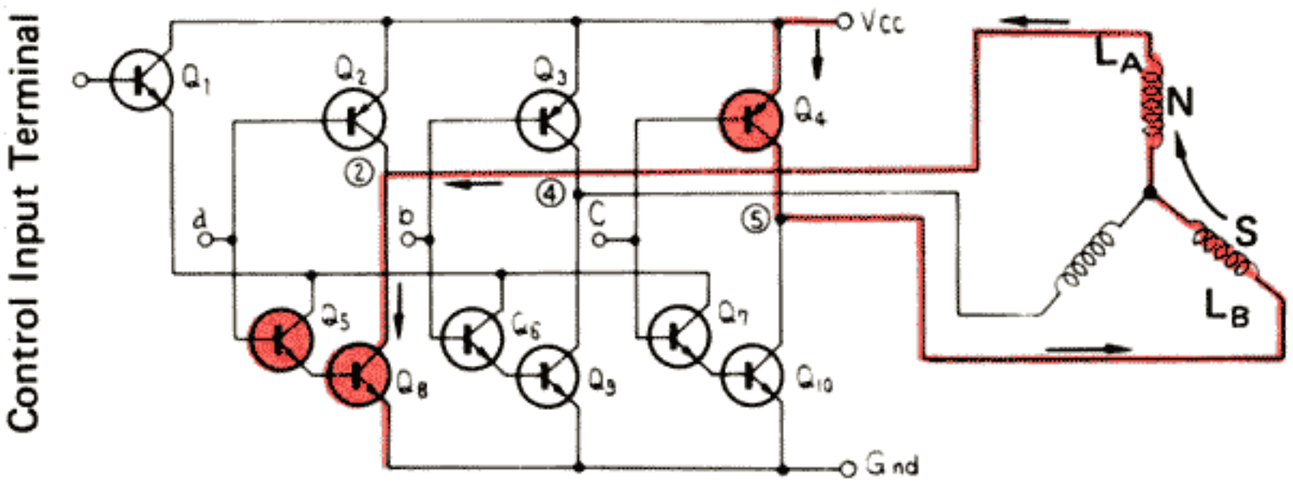


Fig. 11-c

Fig. 11-d



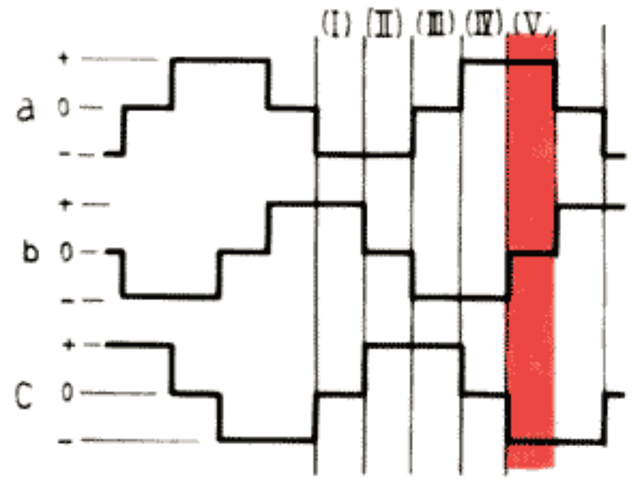
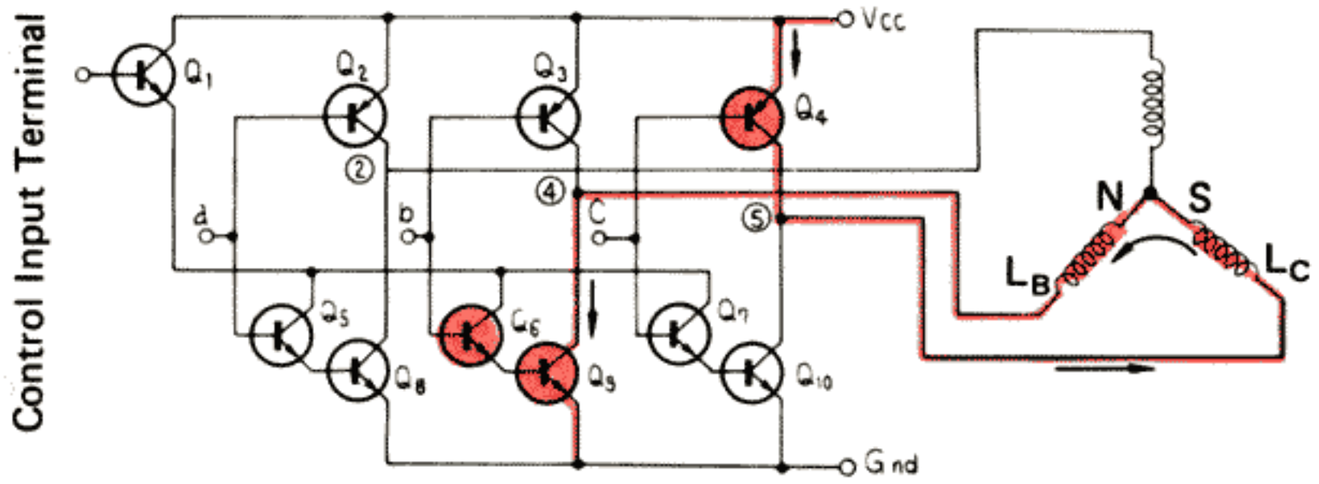


Fig. 11-e



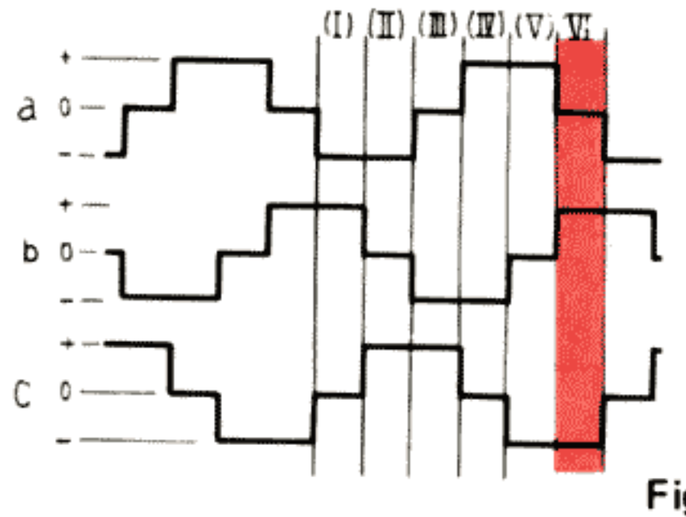


Fig. 11-f

8. Reverse Rotation Prevention

1. PXM-051 operates indiscriminately in regard to the direction of rotation. If the platter is turned slowly in the reverse direction by hand, a forward torque will be applied until the platter stops, reverses its rotation and reaches rated speed in the proper direction.
2. If, however, the rotational speed in the reverse direction is in excess of 33 or 45 rpm, the Forward/Reverse Command Block may "misread" this as simply excessive speed ("overrun") and apply a reverse torque until rated speed is attained.
3. This reverse torque will further accelerate the turntable rotation in the reverse direction. This is known as "reverse run-away."
4. To prevent this from happening, a Reverse Rotation Prevention circuit has been included.
5. This Reverse Rotation Prevention circuit consists of two flip-flops and AND gates See Fig. 12.
6. The input for this circuit is derived from the Hall element position detection signals processed in the Reverse Rotation Prevention circuit.
7. As long as the platter is rotating in the proper direction, this pulse enters in the order B — A — C, and no "reverse" command is generated.
8. If, however, the platter rotates in the reverse direction, the pulse order becomes A — B — C, and a corrective command is given to the Forward/Reverse Command Circuit.

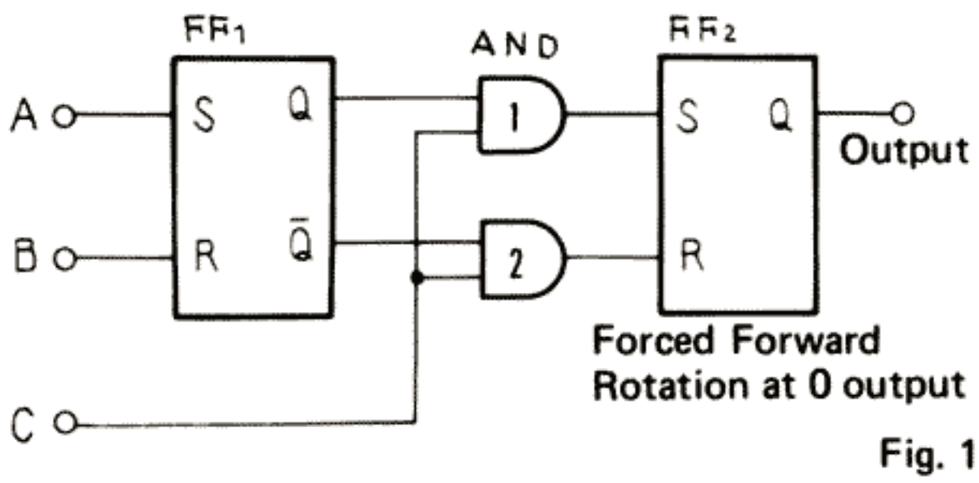


Fig. 12

		FF1				C	AND		FF2
		S	R	Q	Q̄		1out	2out	Q
Forward rotation	B	0	1	0	1	0	0	0	—
	↓								
	A	1	0	1	0	0	0	0	—
	↓								
	C	0	0	1	0	1	1	0	1
Reverse rotation									
	A	1	0	1	0	0	0	0	—
	↓								
	B	0	1	0	1	0	0	0	—
	↓								
	C	0	0	0	1	1	0	1	0

Fig. 12 Truth table

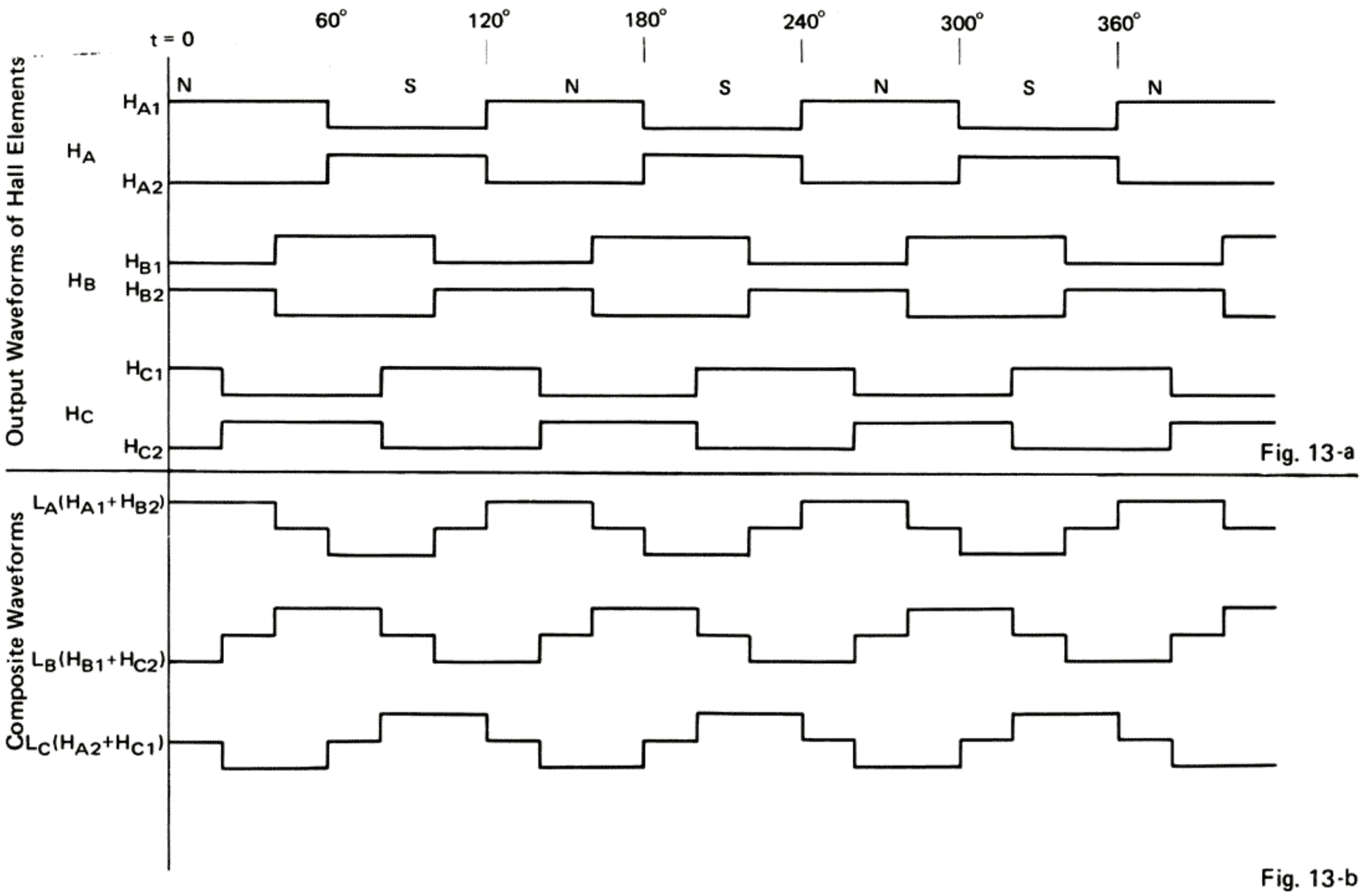
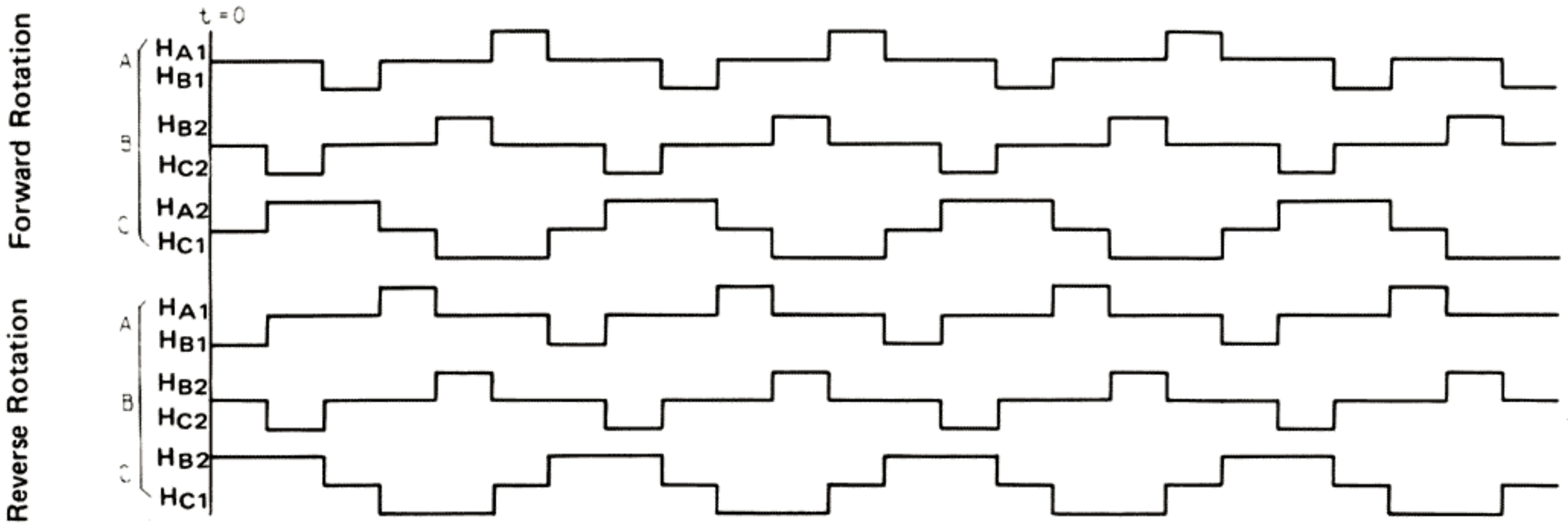


Fig. 13-a

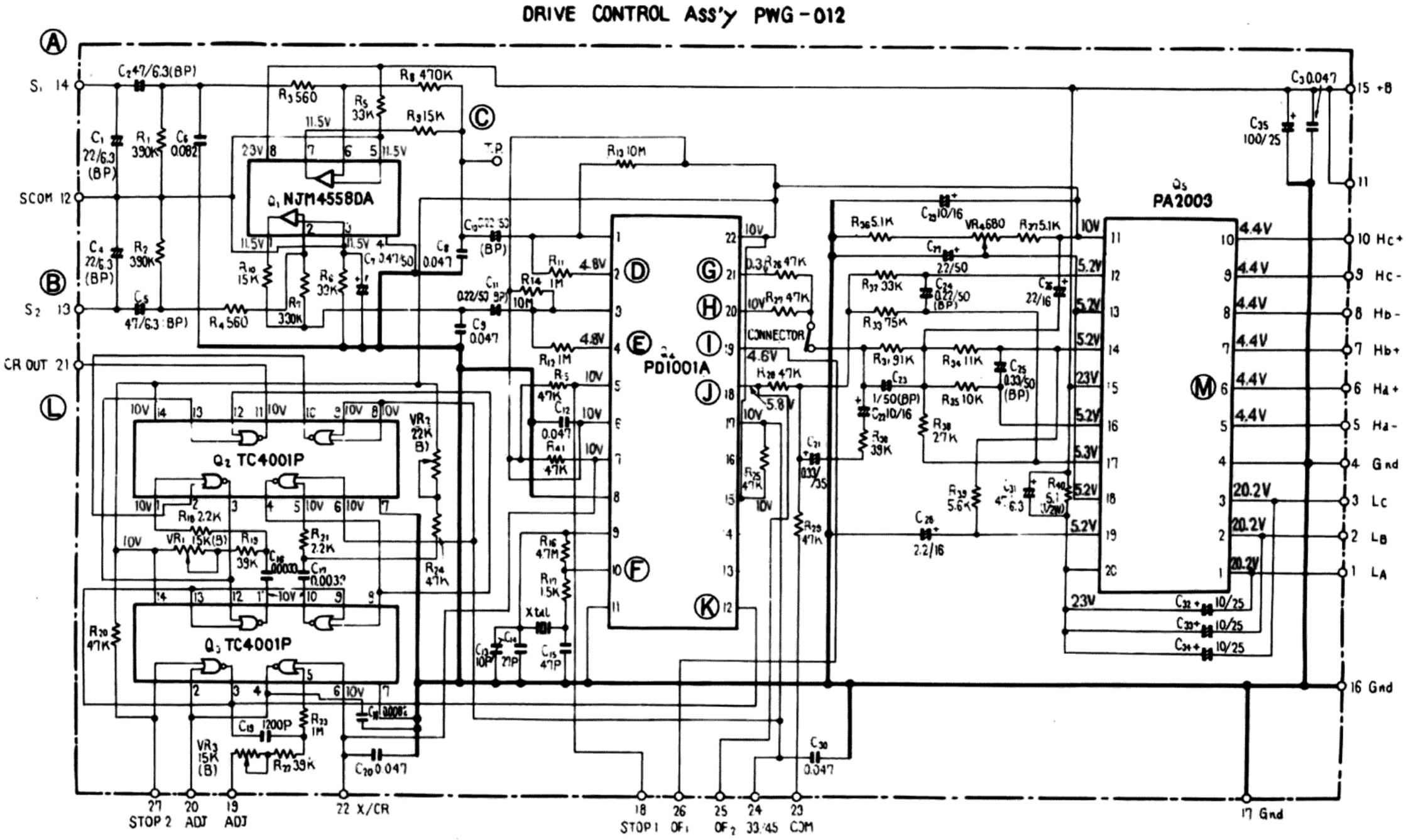
Fig. 13-b

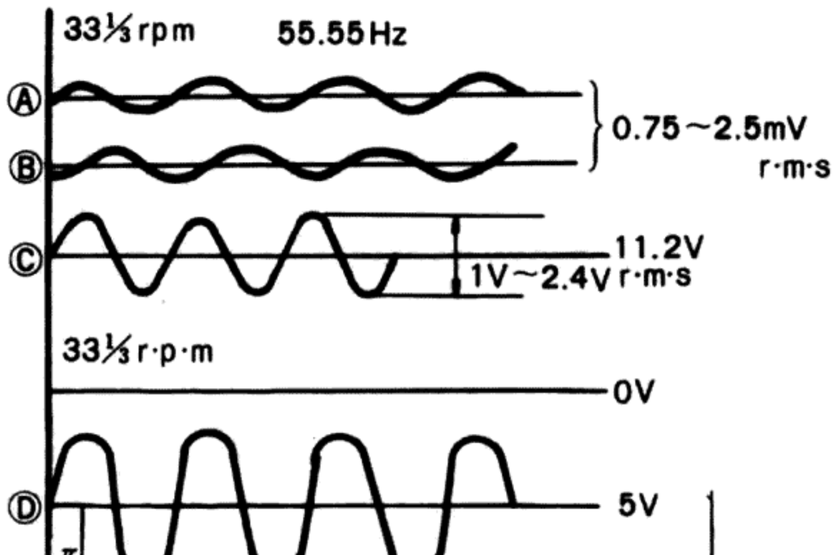


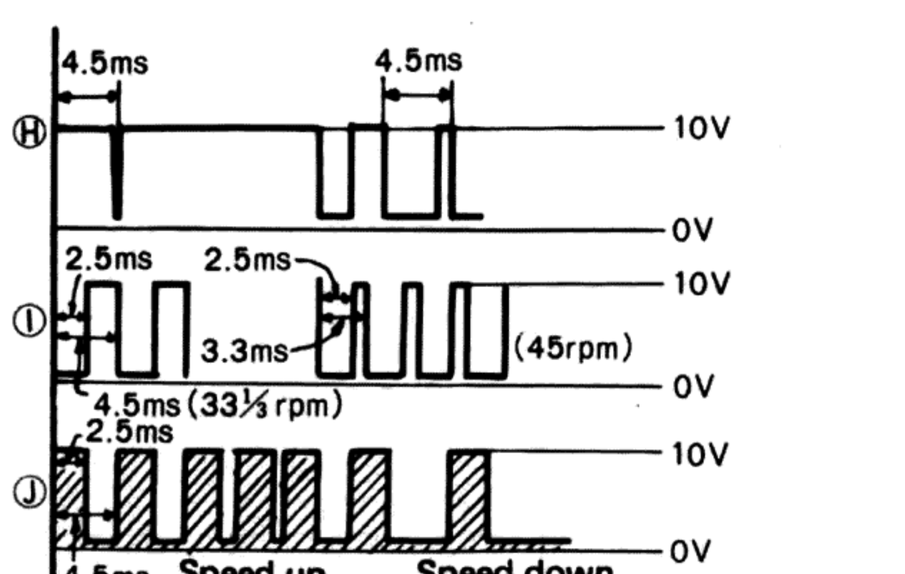
Forward Rotation B → A → C
Reverse Rotation A → B → C

Fig. 14

10.3 WAVEFORMS

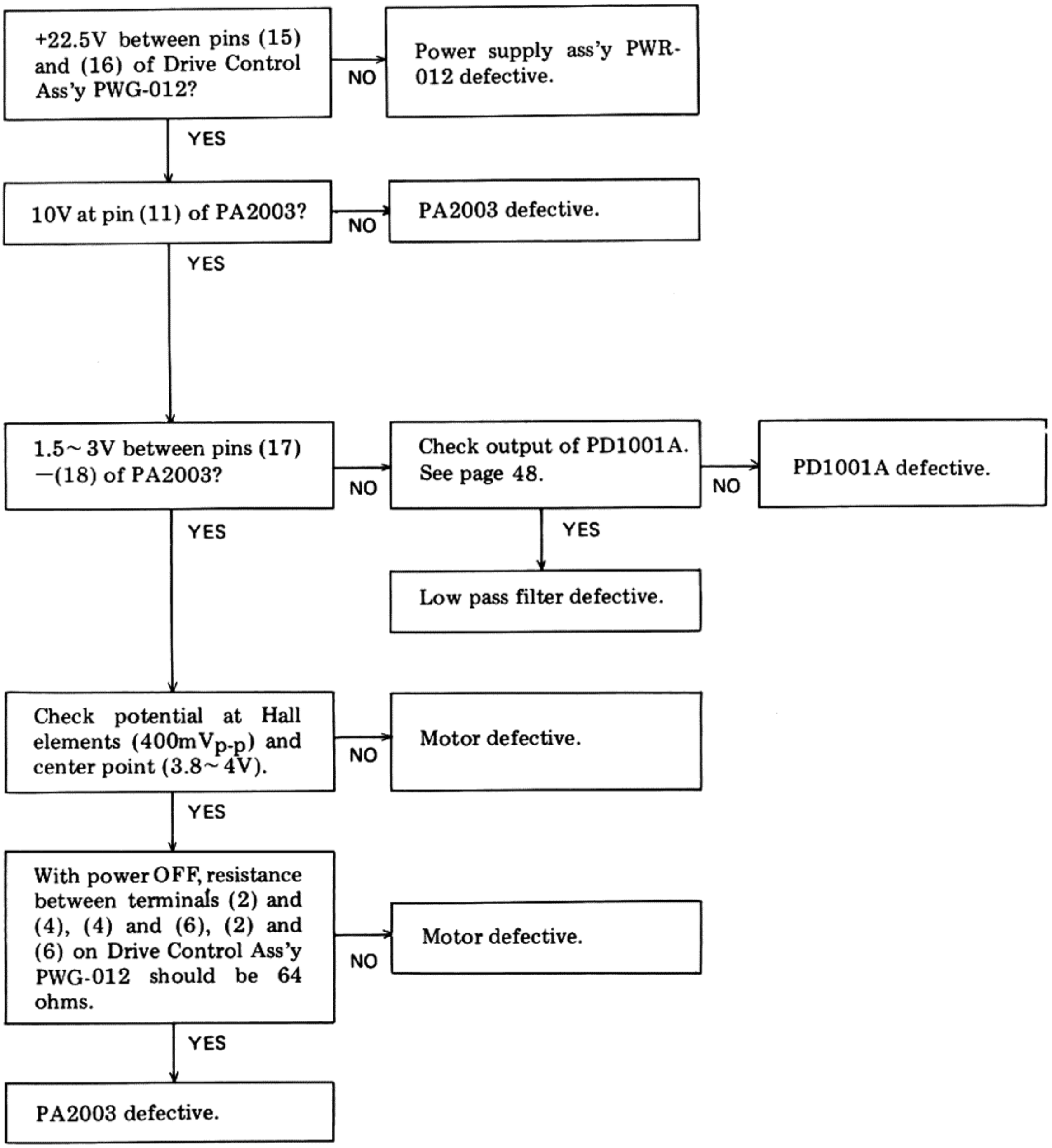




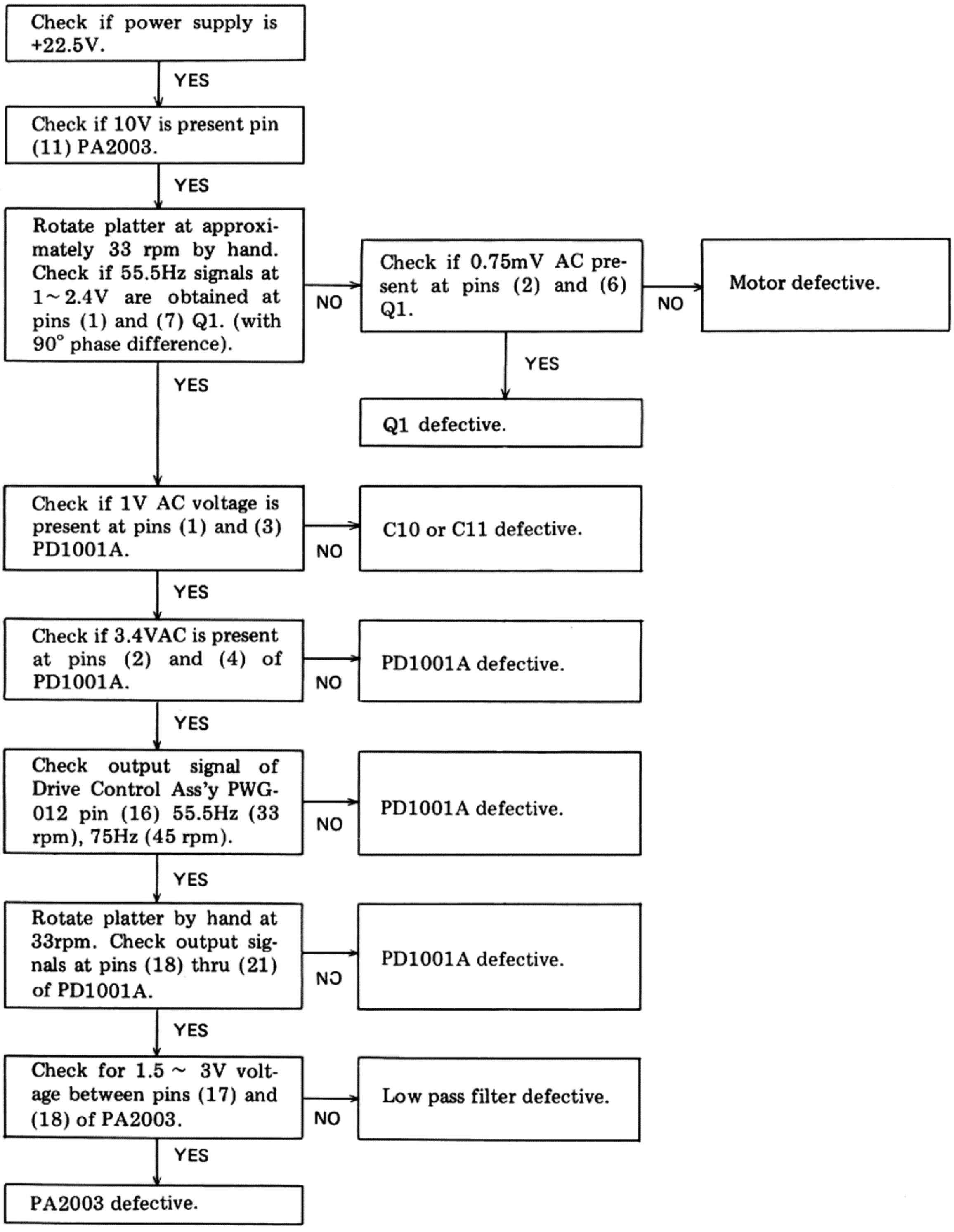


11. TROUBLE SHOOTING GUIDE

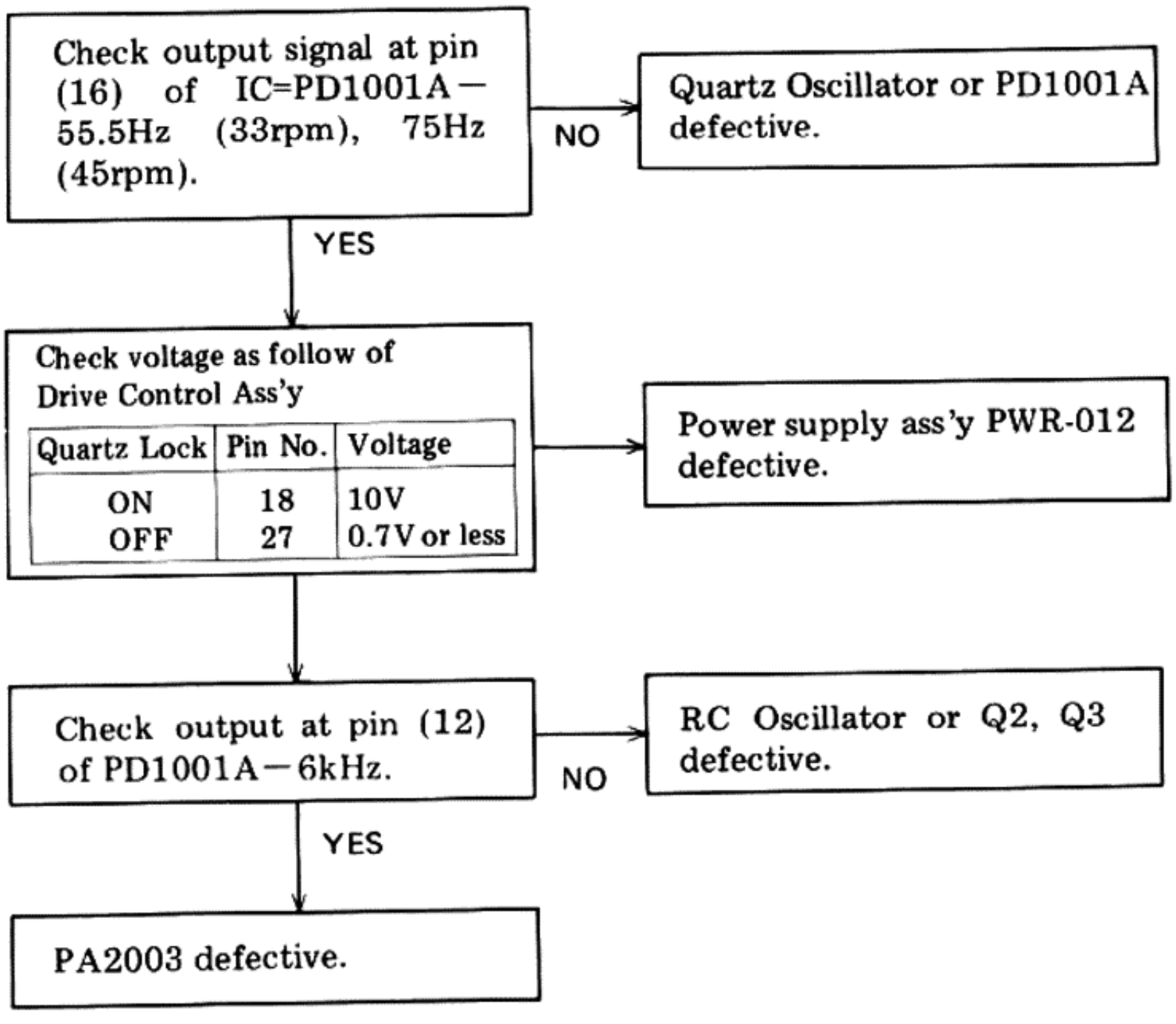
11.1 MOTOR DOES NOT ROTATE



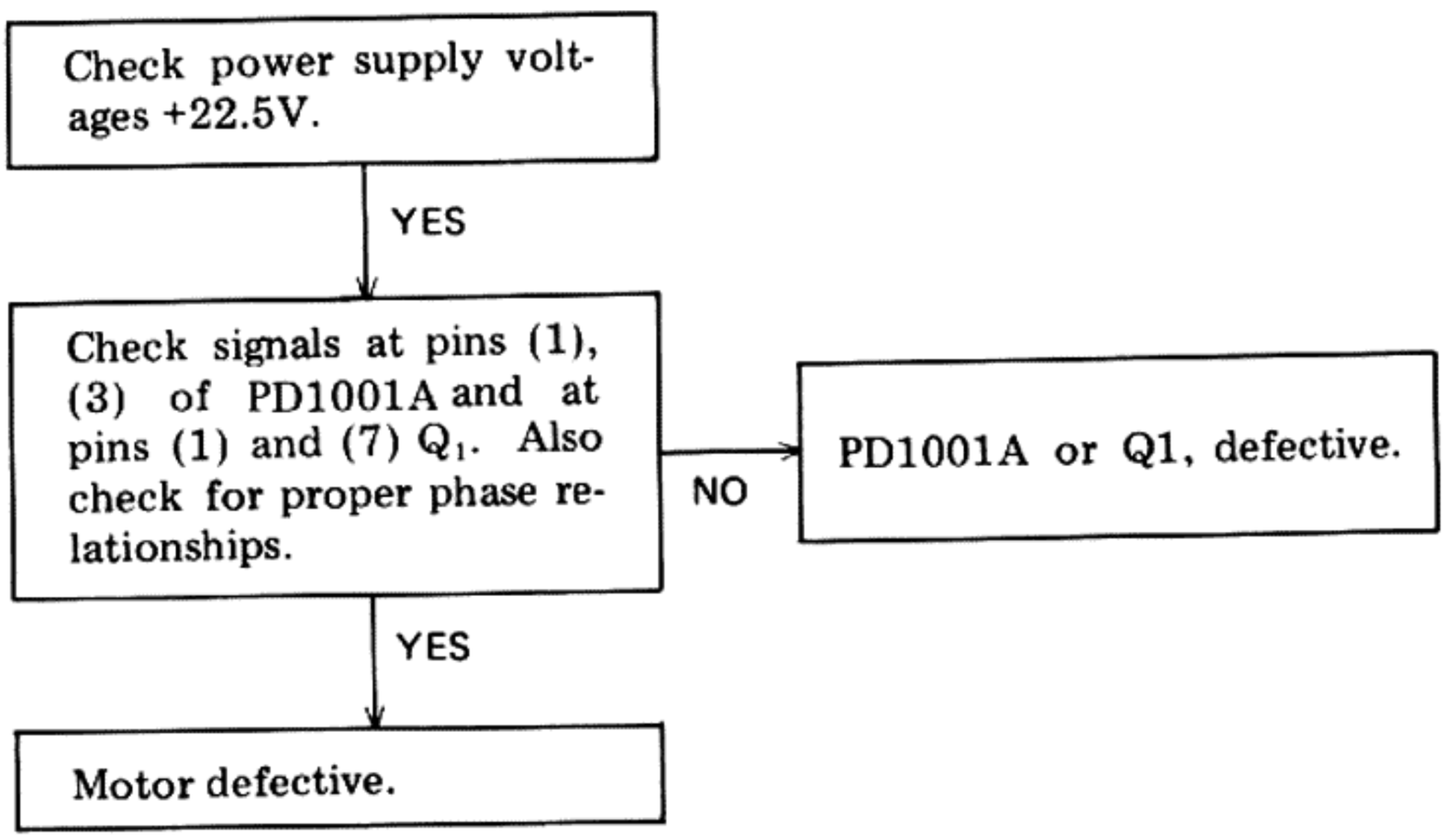
11.2 MOTOR RUN-AWAY



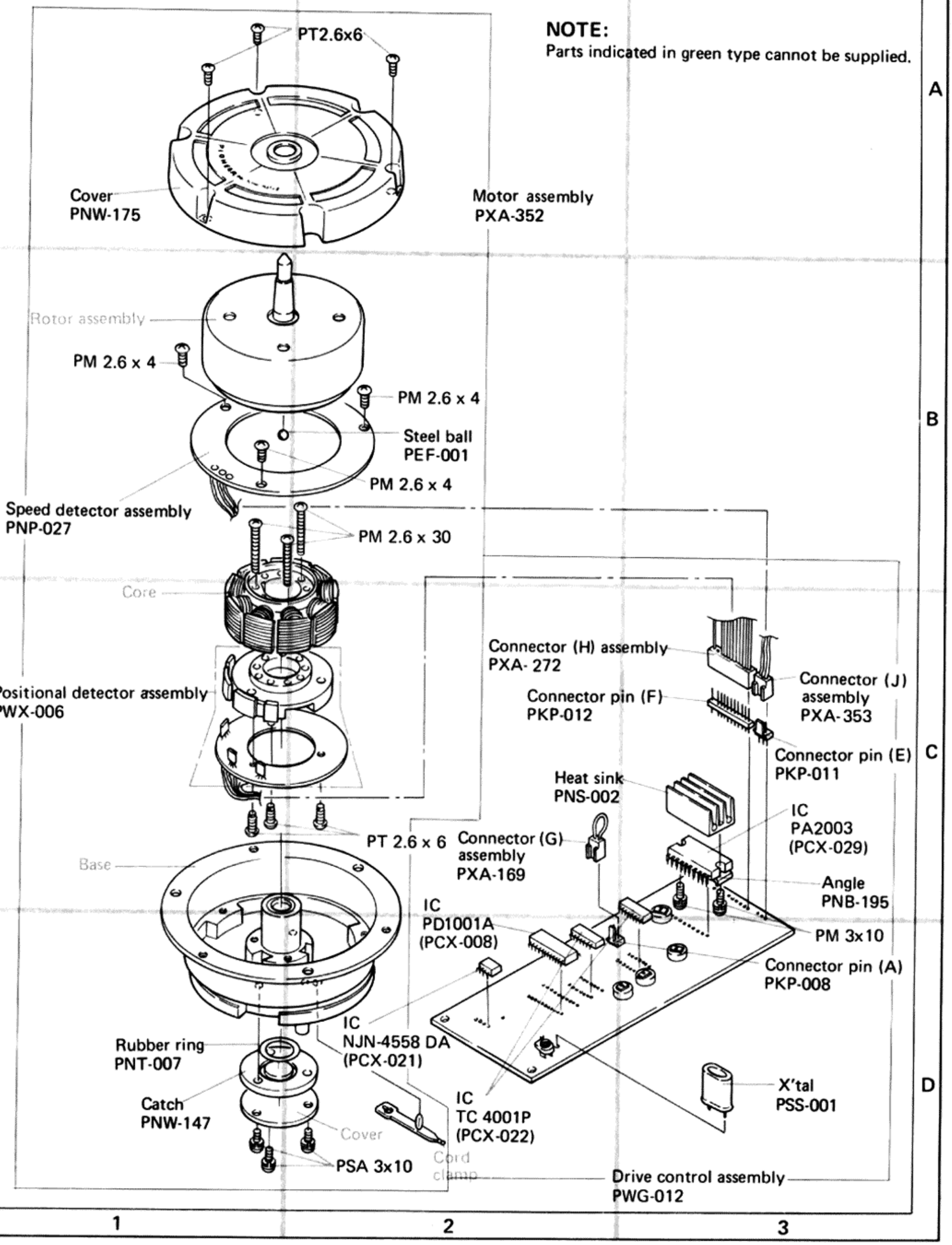
11.3 MOTOR ALTERNATES BETWEEN FORWARD AND REVERSE ROTATION



11.4 UNSTABLE ROTATION NEAR RATED SPEED



12. D.D. MOTOR EXPLODED VIEW



NOTE:
Parts indicated in green type cannot be supplied.

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